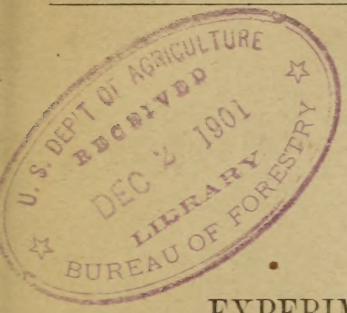
U. S. DEPARTMENT OF AGRICULTURE.

DIVISION OF VEGETABLE PATHOLOGY.

BULLETIN NO. 3.



REPORT

ON THE

EXPERIMENTS MADE IN 1891

IN THE

TREATMENT OF PLANT DISEASES.

BY

B. T. GALLOWAY.

PUBLISHED BY AUTHORITY OF THE SECRETARY OF AGRICULTURE.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
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PUBLICATIONS OF THE SECTION OF VEGETABLE PATHOLOGY.

JOURNALS.

Journal of Mycology, vol. v, Nos. 1, 2, 3, 4, 1889–'90, pp. 249, pl. 14. Vol. vi, No. 1, pp. 44, pl. 2.

BULLETINS.

No. 2. Fungous Diseases of the Grape. 1886, pp. 136, pl. 7.
No. 5. Report on the Experiments made in 1887 in the treatment of Downy Mildew and Black Rot of the Grape. 1888, pp. 113.
No. 7.* Black Rot. 1888, pp. 29, pl. 1.
No. 8.* A Record of Some of the Work of the Division. 1889, pp. 69.
No. 9. Peach Yellows. 1889, pp. 254, pl. 36.
No. 10. Report on the Experiments made in 1888 in the Treatment of Downy Mildew and Black Rot of the Grape, pp. 61.
No. 11. Report on the Experiments made in 1889 in the Treatment of Fungous Diseases of Plants. 1890, pp. 119.

CIRCULARS.

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No. 2. Grapevine Mildew and Black Rot. 1885, pp. 3.
No. 3.* Treatment of Grape Rot and Mildew. 1886, pp. 2.
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JOURNALS.

Journal of Mycology, vol. vi, Nos. 2, 3, and 4.* 1890–'91, pp. 45–207, pl. 16. Vol. vii, Nos. 1, 2,* 1891–'92, pp. 1–194, pl. 17.

BULLETINS.

Farmers' Bulletin No. 4. Fungous Diseases of the Grape and their Treatment. 1891, pp. 12.
No. 1.* Additional Evidence on the Communicability of Peach Yellows and Peach Rosette. 1891, pp. 65, pl. 39.
Farmers' Bulletin No. 5.* Treatment of Smuts of Oats and Wheat. 1892, pp. 8, pl. 1.
Farmers' Bulletin No. 7.* Spraying Fruits for Insect Pests and Fungous Diseases. 1892, pp. 20.
In press.—Bulletin No. 2. The California Vine Disease. 1892, pp. 222, pl. 27.

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U. S. DEPARTMENT OF AGRICULTURE,
DIVISION OF VEGETABLE PATHOLOGY,
Washington, D. C., July 15, 1892.

SIR: I have the honor to submit herewith Bulletin No. 3 of this Division, giving an account of the experiments conducted during the season of 1891 in the treatment of plant diseases. The report of D. G. Fairchild on work conducted in New York State is also given.

Respectfully,

B. T. GALLOWAY,
Chief of Division.

Hon. J. M. RUSK,
Secretary.

TREATMENT OF PLANT DISEASES.

By B. T. Galloway.

INTRODUCTION.

The work set forth in the accompanying pages was conducted in the vicinity of Washington, D. C., Geneva, N. Y., and Ithaca, Wis. In order that as many of the experiments as possible might at all times be under personal supervision, the work was confined for the most part to the vicinity of Washington, such localities as offered the best means of obtaining the desired information being selected in every case. Thus for the work on pear and peach diseases orchards on the Delaware peninsula were chosen. Work on grape diseases was carried on at Sterling, Va., a region peculiarly adapted to the culture of this fruit, but now in bad repute on account of black rot and other maladies. The nursery work was divided between Franklin Davis's place, at Mullikin, Md., and Geneva, N. Y. Apple scab was also under investigation in New York, but the work on this disease was for the main part confined to Wisconsin. The Wisconsin experiments were in charge of Prof. E. S. Goff, while the New York work was placed in the hands of Mr. D. G. Fairchild, an assistant in the Division. The entire field-work near Washington, including the preparation and application of fungicides, was conducted by Mr. P. H. Dorsett, a special agent of the Division. In making critical notes on the work Mr. W. T. Swingle rendered valuable assistance, while Mr. Fairchild assisted in the preparation of the formulæ for fungicides.

EXPERIMENTS IN THE TREATMENT OF THE BLACK ROT OF THE GRAPE.

For this work a vineyard at Sterling, Va., 30 miles southwest of Washington, was selected. Experiments in the treatment of other vine diseases were also made by a number of agents in different parts of the country. In this paper, however, we shall give the results of the work in Virginia only, it being for the most part along new lines, while the others were largely confirmatory of previous investigations.

The experiments were designed to obtain definite information on five principal questions, as follows:

(1) A comparison of eight fungicides, each containing approximately the same amount of the compound of copper as the ammoniacal solution of copper carbonate, (*a*) as regards their effect on the healthy foliage, flowers, and fruit; (*b*) their efficacy as preventives of black rot; and (*c*) their relative cost. The formulæ for the fungicides are given below:

1. AMMONIACAL SOLUTION.

Copper carbonate	ounce	½
Aqua ammonia (26°)	ounces	6
Water	gallons	4½

The copper carbonate was first mixed with sufficient water to form a thick paste. The ammonia was then slowly added until the solution became perfectly clear. Sometimes it requires more than 6 ounces of ammonia, sometimes less.

2. MODIFIED EAU CELESTE.

Copper sulphate	ounces	2½
Sodium carbonate	do	3
Aqua ammonia	do	2
Water	gallons	6½

The copper sulphate and carbonate of soda were each dissolved in half a gallon of water, using separate vessels for the purpose. The two solutions were then mixed, the ammonia was poured in, and sufficient water added to make 6½ gallons.

3. PRECIPITATED COPPER CARBONATE SOLUTION.

Copper sulphate	ounces	2½
Sodium carbonate	do	3
Water	gallons	6½

The copper sulphate was dissolved in half a gallon of water, the carbonate of soda was then stirred in and the solution diluted to 6½ gallons.

4. COPPER SACCHARATE.

Copper sulphate	ounces	2½
Sodium carbonate	do	3
Cheap molasses	do	3
Water	gallons	6½

This was prepared exactly like No. 3, the molasses being added last.

5. GLUE MIXTURE.

Copper sulphate	ounces	2½
Sodium carbonate	do	3
Cheap glue	do	2
Water	gallons	6½

Prepared in the same way as No. 4.

6. BORDEAUX MIXTURE.

Copper sulphate	ounces	6
Lime (unslaked)	do	4
Water	gallons	7½

This was made in the usual way by dissolving in one vessel the copper and slaking the lime in another, then mixing the two solutions, and diluting to 7½ gallons.

7. COPPER ACETATE.

Copper acetate	ounce	½
Water	gallons	5

The copper acetate was simply dissolved in the water 24 hours previous to using it.

8. COPPER CHLORIDE MIXTURE.

Copper sulphate	ounce	½
Calcium chloride	do	½
Water	gallons	5

The copper sulphate was dissolved in a quart of water and the calcium chloride was treated in the same way. The two solutions were then poured together, and enough water added to make 5 gallons.

In preparing the fungicides the ammoniacal solution of copper carbonate, containing 5 ounces of copper carbonate and 5 pints of aqua ammonia to 45 gallons of water was taken as the standard. In other words, all the other fungicides used contained approximately the same amount of the compound of copper as the ammoniacal copper carbonate solution, standard strength. It seemed especially desirable to test the fungicides in this way, since, if it were found, for example, that the Bordeaux mixture, containing only 12 ounces of copper sulphate to 22 gallons of water, was as effective against black rot as the old formula, in which 6 pounds to 22 gallons were used, there would be a great saving in cost and a decided advantage as regards ease of preparation and application. Moreover, on account of the nature of copper, hygienically considered and as regards its effect on the soil from long-continued use, it is important to reduce the amount applied to a minimum.

The second question upon which information was desired may be briefly stated as follows:

(2) A comparison of two fungicides containing no copper with those given under question 1.

The fungicides used in this case were—

9. POTASSIUM SULPHIDE SOLUTION.

Potassium sulphide	ounce	½
Water	gallons	5

The potassium sulphide was added to the full quantity of water and then stirred until it was dissolved.

10. SODIUM HYPOSULPHITE SOLUTION.

Sodium hyposulphite	ounce	½
Water	gallons	5

This was prepared the same as No. 9.

It was thought that such a test would be of value in view of the fact that the fungicides in question had never been extensively used for black rot.

The third and fourth questions we give below:

(3) A comparison of Bordeaux mixture, full strength, with the same preparation, half strength. Following are the formulæ:

BORDEAUX MIXTURE, FULL STRENGTH.

Copper sulphate	pounds	6
Lime (unslaked)	do	4
Water	gallons	22

BORDEAUX MIXTURE, HALF STRENGTH.

Copper sulphate	pounds	3
Lime (unslaked)	do	2
Water	gallons	22

This experiment was designed largely as a check on the one where the copper in the Bordeaux mixture was reduced to less than one-sixth the usual quantity.

(4) A comparison of the Bordeaux mixture, full and half strength, applied early and late. By early treatment is meant that two applications were made before the fruit set. By late, that treatment was postponed until the berries were the size of bird shot. The question is often asked whether it is worth while to spray after the berries are well formed or after the rot has already appeared. To obtain some definite information on this point was the main object of this experiment.

The fifth question upon which information was desired may be briefly stated, as follows:

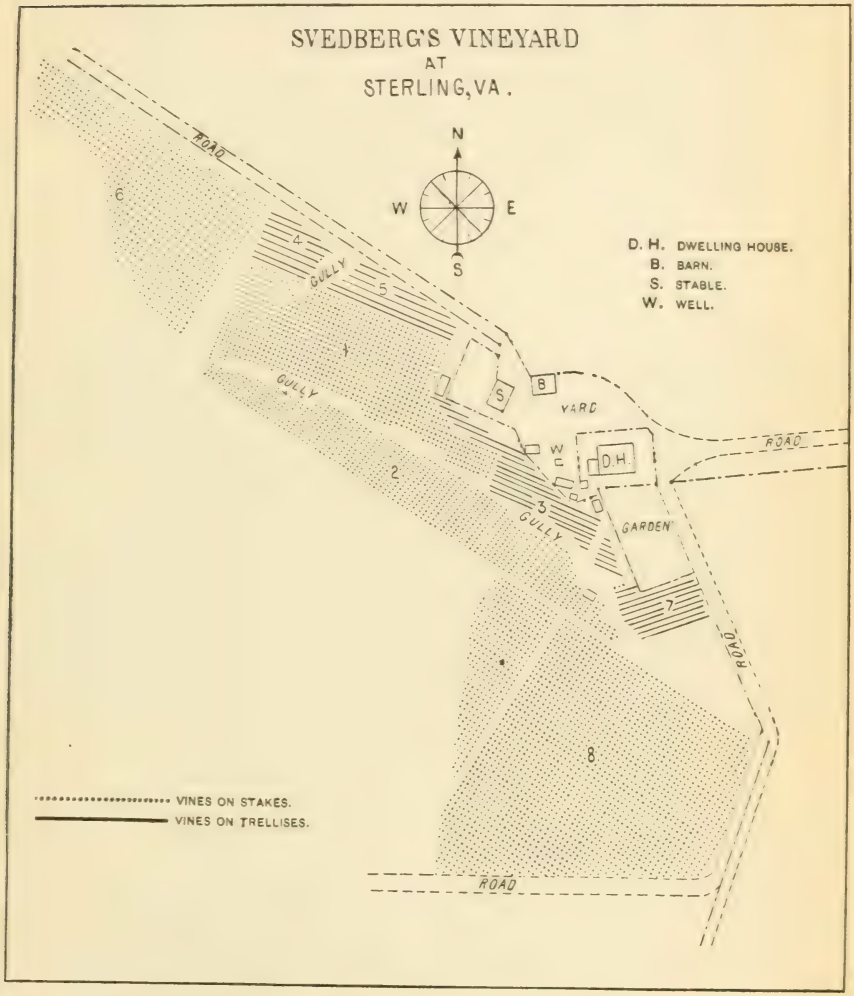
(5) A comparison of six treatments using Bordeaux mixture, full and half strength, with four treatments, both beginning at the same time, *i. e.*, when the leaves were first starting.

Taking it for granted that the foregoing remarks have clearly brought out the design of the work, we may now turn directly to the experiments.

The vineyard in which the work was carried on consists of 6,944 vines, the principal varieties being Concord, Clinton, Nortons, Virginia, Elvira, Ives, and Missouri Riessling. Nearly all the vines were in first-class condition, having been carefully pruned and cultivated every year since they were planted. Despite this, however, the fruit during the past three years rotted badly, nearly all of the crop being destroyed. For the experiments with the eight copper and two noncopper fungicides 750 Concord vines were selected in the block marked *1* on the chart below.

This block contained 1,485 vines, most of which were Concords 8 years old, planted 6 feet apart each way and trained to stakes 8 feet high. Two hundred vines, or 20 for each fungicide, were treated, leaving 340 for control. These were selected in such a way as to nearly surround each treated vine, thus furnishing a very severe test for the fungicides.

DIAGRAM 1.—*Arrangement of vines in Svedberg's vineyard at Sterling, Va.*



For the experiments with Bordeaux mixture, full and half strength, and early against late treatments, 160 vines in block 6 were selected. These vines were 6 years old, planted 6 feet apart each way, and trained as in block 1. The 160 vines selected were divided in 16 plats of 10 vines each. In each plat there were 8 Concord and 2 Clinton vines, thus affording an opportunity to test the treatment of two varieties. Each alternate plat, consisting of a single row running nearly east and west,

was sprayed, while the others arranged in the same way were left for control.

The treatments, six in number in every case, were made on the same day, the date for each being as follows:

(1) *April 27.*—All plats, excepting controls, in Vineyard 1; also plats treated early with Bordeaux mixture, full and half strength, in Vineyard 6.

(2) *May 13.*—All plats same as 1.

(3) *May 25.*—All plats same as 1 and 2.

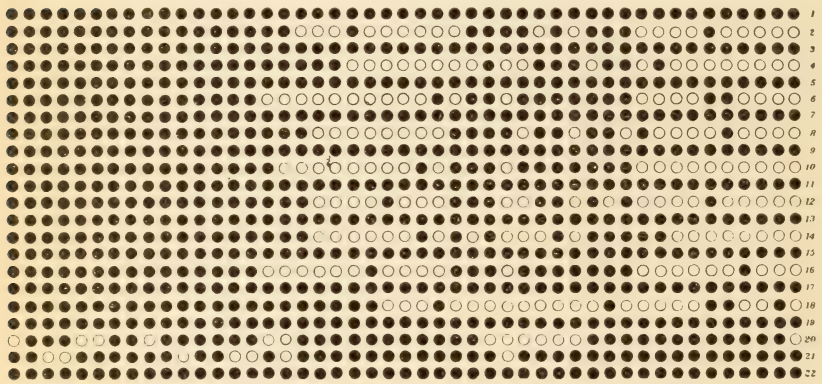
(4) *June 9.*—All plats, including those left in Vineyard 6 for late treatment with Bordeaux mixture, full and half strength.

(5) *June 22.*—All plats, excepting two in Vineyard 6, treated early with Bordeaux mixture, full and half strength. The treatments in the case of these two plats were stopped after the fourth spraying, in accordance with plans set forth in question 5.

(6) *July 7.*—Same as 5.

The arrangement of the plats, manner of treatment, and number of sprayings are set forth in the diagrams which follow:

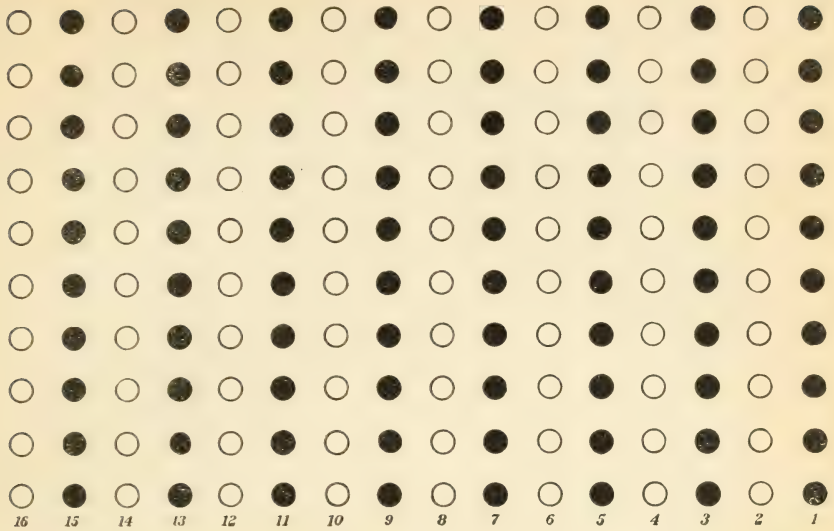
DIAGRAM 2.—*Plan of experiment in Vineyard 1.*



EXPLANATION OF DIAGRAM 2.

(1) Untreated.
(2) Ammoniacal solution of copper carbonate.
(3) Untreated.
(4) Modified eau celeste.
(5) Untreated.
(6) Precipitated copper carbonate solution.
(7) Untreated.
(8) Copper saccharate solution.
(9) Untreated.
(10) Glue mixture.
(11) Untreated.
(12) Bordeaux mixture.
(13) Untreated.
(14) Copper acetate.
(15) Untreated.
(16) Copper chloride mixture.
(17) Untreated.
(18) Potassium sulphide solution.
(19) Untreated.
(20 and 21) Sodium hyposulphite solution.
(22) Untreated.

DIAGRAM 3.—*Plan of experiment in Vineyard 6.*



EXPLANATION OF DIAGRAM 3.

(1) Untreated.
(2) Bordeaux mixture, full strength, applied early.
(3) Untreated.
(4) Bordeaux mixture, half strength, applied early.
(5) Untreated.
(6) Bordeaux mixture, full strength, applied late.
(7) Untreated.
(8) Bordeaux mixture, half strength, applied late.
(9) Untreated.
(10) Bordeaux mixture, full strength, early; four sprayings.
(11) Untreated.
(12) Bordeaux mixture, full strength, early; three sprayings.
(13) Untreated.
(14) Bordeaux mixture, half strength, early; four sprayings.
(15) Untreated.
(16) Bordeaux mixture, half strength, early; three sprayings.

The results of the work can probably be more clearly set forth by treating the matter under two heads, namely:

(1) Result of experiments in Vineyard 1.
(2) Result of experiments in Vineyard 6.

(1) RESULT OF EXPERIMENTS IN VINEYARD 1.

First treatment.—On April 27, when the treatments began, the weather was exceedingly dry, no rain having fallen for three weeks. The vines were just beginning to grow, the leaves averaging from 1 to 1½ inches in diameter.

Second treatment.—At the time of this treatment, May 13, the weather was still very dry, only light showers having fallen since the last spraying. No injury whatever resulted from the first treatment, the vines in every respect being perfectly healthy. To obtain some definite information upon which to base future observations 40 representative vines.

taken alternately from the treated and untreated, were selected and measured as follows:

(1) Total height of vines.
(2) Total number of shoots on each vine.
(3) Total length of shoots.
(4) Total number of leaves.
(5) Diameter of each leaf.

From these figures the following averages were obtained:

TREATED VINES.

Average height	feet..	3.67
Average number of shoots		28.35
Average length of shoots	inches..	7.84
Average number of leaves per shoot		3.60
Average diameter of leaves	inches..	3.20

UNTREATED VINES.

Average height	feet..	3.11
Average number of shoots		28.9
Average length of shoots	inches..	10.0
Average number of leaves per shoot		3.4
Average diameter of leaves	inches..	3.3

It will be seen from these figures that the condition of the vines, as regards size and growth, were practically the same on the treated and untreated plats.

Third treatment.—This treatment, on May 25, was made just after a rain, the first of any consequence since the work began. The vines at this time were in full bloom. No black rot or other disease had appeared. A careful examination of the vines showed that those in plats 1, 2, 3, 4, and 5 were slightly injured by the treatments, the leaves in most cases being scorched near the edges. All the other plats were perfectly healthy. Measurements the same as in the case of the second treatment, with the exception of the total height of the vines, were again made, the result being as follows:

TREATED VINES.

Average number of shoots		41.21
Average length of shoots	inches..	16.99
Average number of leaves per shoot		5.75
Average diameter of leaves	inches..	4.18x3.71

UNTREATED VINES.

Average number of shoots		38.98
Average length of shoots	inches..	15.56
Average number of leaves per shoot		5.54
Average size of leaves	inches..	4.58x3.51

An examination of the foregoing figures and a comparison of them with those given under the second treatment brings out several interesting points. First, it will be seen that the number of shoots on the treated vines increased 4.53+ per cent during the twelve days which elapsed between the second and third sprayings. On the untreated

ones the increase was 3.48+ per cent. As regards length or growth of shoots, the increase on the treated vines was 116.70+ per cent. In view of the fact that no diseases of consequence appeared from the time of the first till the third treatment, it seems hardly likely that the increase in growth was due to the sprayings. We are inclined to believe that the difference, as brought out by these figures, was due to causes wholly outside of the work in hand.

Unless in cases where the leaves and shoots are being rapidly destroyed by some active parasite, the effect of treatment on growth is not to be looked for until the following season; providing, of course, there is no injury from the applications.

Fourth treatment.—This was made on June 9, the vines, owing to recent heavy rains, being in excellent condition. The foliage was nearly grown, while the fruit was about the size of bird shot. Below we give our field notes as regards the condition of each plat with respect to injury to the foliage from the treatment and from black rot. The latter was confined wholly to the leaves, this being the first time its presence was noted, although from the general condition of the vineyard it is probable that an examination four or five days earlier would have revealed it. It is safe to say, however, that black rot appeared beween June 5 and 9.

Plat 1.—No treatment. No black rot.

Plat 2.—Ammoniacal solution. Ten of the vines have their leaves slightly injured, the edges being reddish in color and more or less curled. No black rot whatever was found on any of the vines.

Plat 3.—No treatment. One vine has its leaves affected with black rot.

Plat 4.—Five vines slightly injured. No black rot.

Plat 5.—No treatment. Foliage in good condition; no black rot.

Plat 6.—Precipitated carbonate of copper solution. Five vines slightly scorched; no black rot.

Plat 7.—No treatment. Foliage in good condition; no black rot.

Plat 8.—Copper saccharate. Seventeen of the vines are slightly scorched, the edges of the leaves being curled; no black rot.

Plat 9.—No treatment. Foliage in good condition; no black rot.

Plat 10.—Glue mixture. The leaves of 12 vines are considerably scorched; no black rot.

Plat 11.—No treatment. Foliage in good condition; black rot on one vine.

Plat 12.—Bordeaux mixture. Foliage perfect in every particular.

Plat 13.—No treatment. No injury whatever.

Plat 14.—Copper acetate solution. Two vines have their leaves scorched; no black rot.

Plat 15.—No treatment. Black rot on the leaves of one vine, otherwise all parts in good condition.

Plat 16.—Copper chloride mixture. Foliage not injured by the treatment; black rot on four vines.

Plat 17.—No treatment. Foliage in perfect condition.

Plat 18.—Potassium sulphide solution. No injury from the spraying and no black rot.

Plat 19.—Untreated. Three vines affected with black rot.

Plat 20.—Sodium hyposulphite solution. Foliage slightly injured and three vines affected with black rot.

At this time it was deemed advisable to determine the amount of fruit on all the vines in the experimental block. Accordingly the number of clusters on each vine was counted, and from this the following data were obtained:

TABLE 1.—*Showing the total number of healthy grape clusters on each plat June 9; also the average number of clusters per vine.*

Plat.	Kind of treatment.	Total No. of clusters.	Average No. of clusters per vine.
2	Ammoniacal solution	376	18.80
3	No treatment	385	19.25
4	Modified eau celeste	371	18.55+
5	No treatment	355	17.75+
6	Precipitated carbonate of copper solution	323	16.15+
7	No treatment	324	16.20
8	Copper saccharate	360	18.00
9	No treatment	367	18.35
10	Glue mixture	381	19.05+
11	No treatment	330	16.50+
12	Bordeaux mixture	416	20.80
13	No treatment	285	14.25
14	Copper acetate	361	18.05+
15	No treatment	382	19.10
16	Copper chloride mixture	342	17.10
17	No treatment	329	16.45
18	Potassium sulphide solution	417	20.85
19	No treatment	316	15.80
20–21	Sodium hyposulphite	193	9.65
22	No treatment	180	9.00

It will be seen from the foregoing figures that 6,793 clusters of grapes free from black rot were on the vines June 9. Three thousand five hundred and forty of these were on the treated vines, while 3,253 were on the untreated. In other words, up to the time these observations were made there was practically no difference, so far as the number of clusters was concerned, between the treated and untreated plats.

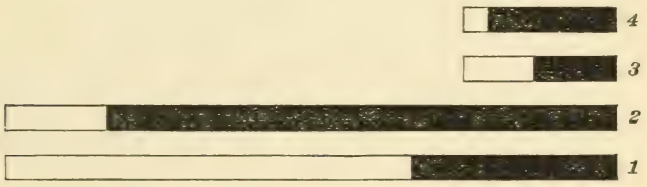
Fifth treatment.—On June 22 the fifth treatment was made, the weather at the time being wet, a heavy rain having fallen on the 21st. The vines in most of the vineyards were growing vigorously, their condition in this respect being about the same as when the last spraying was made. As regards injury to the vines as a result of the treatment, no change took place since the last spraying. Black rot, however, was found to be greatly on the increase, many of the berries showing its effects. It being impracticable to accurately estimate the amount of injury to the berries from this cause, the fruit on each plat was carefully inspected and two divisions made of it. In the first division were placed all vines whose fruit was wholly free from rot, while to the second were referred all vines whose fruit showed the disease. The information thus obtained is set forth in the accompanying table:

TABLE 2.—*Showing the number of vines of the treated and untreated plats having fruit affected with black rot on June 22.*

Plat.	Kind of treatment.	No. of vines affected.
2	Ammoniacal solution	4
3	No treatment	13
4	Modified eau celeste	4
5	No treatment	14
6	Precipitated carbonate of copper solution	9
7	No treatment	16
8	Copper saccharate	4
9	No treatment	16
10	Glue mixture	8
11	No treatment	18
12	Bordeaux mixture	9
13	No treatment	15
14	Copper acetate	8
15	No treatment	15
16	Copper chloride mixture	7
17	No treatment	17
18	Potassium sulphide	8
19	No treatment	15
20–21	Sodium hyposulphite	14
22	No treatment	18

These figures show that of the 160 vines treated with the copper preparations 53, or 33 per cent, were showing signs of black rot on June 22. Of the 160 untreated vines 134, or 83 per cent, were affected with rot. Out of 40 vines treated with the noncopper preparations 22, or 55 per cent, were affected with rot, while out of 40 control vines 33, or 83 per cent, were showing the disease. Representing this graphically we have the following, the dark portion indicating black rot, and the light freedom from the disease.

DIAGRAM 4.—*Showing the total number of vines in the treated and untreated plats, and the per cent of vines affected with black rot.*



EXPLANATION OF DIAGRAM 4.

(1) One hundred and sixty vines treated with copper preparations.
(2) One hundred and sixty vines which received no treatment.
(3) Forty vines treated with noncopper preparations.
(4) Forty vines not treated.

Sixth treatment.—The sixth and last treatment was made on July 7, the weather at the time being damp and sultry. No marked change in regard to injury from the treatments took place between the fourth and sixth sprayings.

At this time a count of all the clusters on both the treated and untreated plats was again made, and in order to get a definite idea as to the effects of the treatments the total number of clusters on each plat was ascer-

tained, and three divisions were made of them. The first, classified as perfect clusters, contained from 1 to 5 diseased berries; the second, classified as part-perfect clusters, contained from 5 to 10 diseased berries; while the third, classified as diseased or worthless clusters, contained 10 or more diseased berries.

These observations enabled us to determine, (1) the total number of clusters on the treated and untreated vines; (2) the total number on each plat; (3) the total number of clusters lost from June 9 to July 7; (4) the number of clusters on each plat lost during the same period; (5) the total number of clusters, and the number on each plat practically free from disease; (6) the total number of clusters, and the number on each plat slightly affected; and finally (7) the total number and the number on each plat destroyed or rendered worthless by the rot.

The results of this count are set forth in the accompanying tables:

TABLE 3.—*Showing the total number of clusters on the vines June 9 and July 7, respectively, and the total number and the per cent lost between these dates.*

	Number of clusters June 9.	Number of clusters July 7.	Per cent lost between June 9 and July 7.
Treated	3,540	3,116	11.9
Untreated	3,253	2,978	8.4
Total	6,793	6,094	

In regard to this loss, we know from careful observations made during the month elapsing between June 9 and July 7, that it was not due to rot or any disease. Many of the clusters which consisted of nothing but old flowers, merely shriveled up and fell off. This partial shedding of the fruit seemed to be normal, the whole vineyard and other vineyards in the vicinity and elsewhere being affected in the same manner. Inasmuch, therefore, as we are principally concerned with the effects of black rot we need only consider the actual state of the vineyard with respect to this disease on July 7, at which time it is safe to say that every cluster injured by rot still remained on the vine.

TABLE 4.—*Showing total number of clusters on each plat July 7, number of perfect clusters, number of part-perfect clusters, number of diseased or worthless clusters, and per cent of perfect clusters.*

Plat.	Kind of treatment.	Total No. of clusters.	No. of perfect clusters.	No. of part-perfect clusters.	No. of diseased clusters.	Per cent of perfect clusters.
2	Ammoniacal solution	346	344	.....	2	99
3	No treatment	340	240	71	29	70
4	Modified eau celeste	315	314	1	.....	99
5	No treatment	355	236	69	50	66
6	Precipitated carbonate of copper solution	322	290	17	15	90
7	No treatment	317	172	96	49	54
8	Copper saccharate	343	343	.....	.....	100
9	No treatment	267	151	48	68	56
10	Glue mixture	315	315	.....	.....	100
11	No treatment	289	160	78	51	55
12	Bordeaux mixture	363	362	1	.....	99
13	No treatment	244	144	59	41	59
14	Copper acetate solution	316	304	7	5	96
15	No treatment	376	211	89	76	56
16	Copper chloride mixture	326	315	8	3	96
17	No treatment	344	185	67	92	53
18	Potassium sulphide solution	291	281	8	2	96
19	No treatment	289	185	53	51	64
20–21	Sodium hyposulphite solution	179	126	31	22	70
22	No treatment	157	100	35	22	63

A study of the foregoing table reveals the fact that the percentage of perfect clusters on the treated plats was 94.5, while on the untreated it was 61.4, a difference of 33.1 in favor of the treated. As regards preventives against rot the various preparations stand as follows:

	Per cent.
I. Copper saccharate, glue mixture	100
II. Bordeaux mixture, ammoniacal solution, modified eau celeste	99
III. Copper acetate solution, copper chloride mixture, potassium sulphide solution	96
IV. Precipitated carbonate of copper solution	90
V. Sodium hyposulphite solution	70

Nothing further was done in the vineyard until September 1, when all the vines were carefully examined and observations made on the following points:

(1) Injury to foliage and wood by the treatments.

(2) Condition of foliage and wood of treated plats with respect to disease.

(3) Number of fruit clusters on each plat.

(4) Number of perfect clusters.

(5) Number of part-perfect clusters.

(6) Number of diseased or worthless clusters.

(7) Per cent of perfect clusters.

After making these observations the fruit was gathered and separated according to the classification already given. Each lot was then weighed and classified as follows:

(1) Total weight of fruit on each plat.

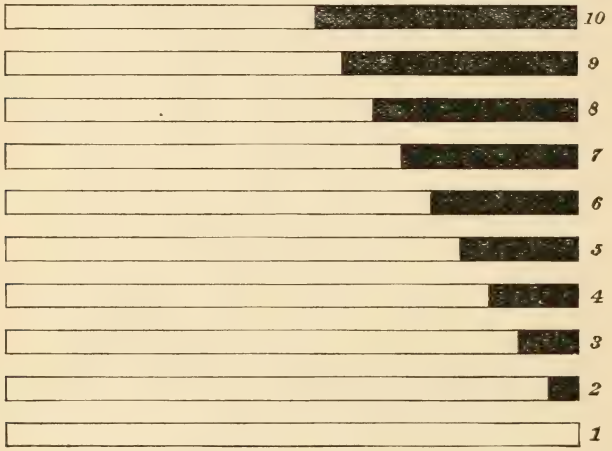
(2) Weight of perfect, part-perfect, and worthless fruit.

(3) Per cent of perfect fruit.

(4) Average weight of perfect, part-perfect, and worthless fruit per vine.

Beginning with the effects of the treatment on foliage and wood, the results are set forth in the accompanying diagram.

DIAGRAM 5.—*Showing the average condition of the foliage and wood September 17 of the treated plats with respect to injury from the spraying. (Black indicates injury.)*



EXPLANATION OF DIAGRAM. 5.

(1) Bordeaux mixture.
(2) Copper acetate solution.
(3) Copper chloride solution.
(4) Ammoniacal solution of copper carbonate.
(5) Precipitated carbonate of copper solution.
(6) Potassium sulphide.
(7) Sodium hyposulphite.
(8) Modified eau celeste.
(9) Glue mixture.
(10) Copper saccharate.

Taking up now the next phase of the question, *i, e.*, the number of clusters on each plat, and also the number of perfect, part-perfect, and worthless clusters, we have the following table:

TABLE 5.—*Showing kind of treatment, total number of clusters, number of perfect, part-perfect, and diseased clusters, and per cent of perfect clusters, September 17.*

Plat.	Kind of treatment.	Total No. of clusters.	No. of perfect clusters.	No. of part-perfect clusters.	No. of diseased clusters.	Per cent of perfect clusters.
2	Ammoniacal solution	346	316	10	20	91.32
3	No treatment	330	146	68	116	44.24
4	Modified eau celeste	310	304	4	2	98.06
5	No treatment	327	106	56	165	32.41
6	Precipitated carb. copper solution	281	243	23	15	86.47
7	No treatment	246	80	61	105	32.52
8	Copper saccharate	336	331	5	.....	98.51
9	No treatment	250	115	42	93	46.00
10	Glue mixture	299	299	.....	.....	100.00
11	No treatment	283	60	29	194	21.20
12	Bordeaux mixture	350	343	4	3	98.00
13	No treatment	239	53	47	139	22.17
14	Copper acetate	315	285	10	20	90.47
15	No treatment	376	60	158	158	15.95
16	Copper chloride solution	317	311	2	4	98.10
17	No treatment	336	226	65	45	67.26
18	Potassium sulphide solution	290	276	13	11	95.17
19	No treatment	289	185	52	52	64.01
20–21	Sodium hyposulphite solution	179	73	27	79	40.78
22	No treatment	150	102	9	39	68.00

A comparison of these figures with those in Table 4, made on July 7, brings out some interesting points. In the first place it will be seen that the total number of clusters did not materially change, the loss being only 235, or 0.40+per cent. There was a considerable change, however, in the figures in the second column and a decidedly marked one in the others. Take plat 3, no treatment. On July 7 there were 240 perfect, 71 part perfect, and 29 worthless clusters on these vines. September 17 there were 146 perfect, 68 part perfect, and 116 worthless, an increase in worthless and a decrease in perfect clusters of 296 and 40 per cent, respectively.

The per cent of perfect clusters on the treated plats, taking them as a whole, was 89.6 against 94.5 when the count was made on July 7. On the untreated plats the per cent was 41 against 61.4 July 7. As preventives against rot the final arrangement of the fungicides, based on the figures in the preceding table, is as follows:

	Per cent.
I. Glue mixture	100
II. Modified eau celeste, copper saccharate, Bordeaux mixture, copper chloride mixture	98
III. Potassium sulphide solution	95
IV. Ammoniacal solution	91
V. Copper acetate	90
VI. Precipitated carbonate of copper solution	86
VII. Sodium hyposulphite solution	40

Turning now to the yield of the various plats by weight, we have the following figures, all fractions of an ounce being omitted.

TABLE 6.—*Showing yield by weight of each plat, weight of perfect, part-perfect, and worthless fruit, and per cent of perfect fruit per plat.*

Plat.	Kind of treatment.	Total yield.	Perfect fruit.	Part-perfect fruit.	Worthless fruit.	Per cent of perfect fruit.
		Lbs. Oz.	*Lbs. Oz.*	*Lbs. Oz.*	*Lbs. Oz.*	
2	Ammoniacal solution	41 9	38 5	1	2 4	91.3
3	No treatment	25 9	11 15	8	5 10	44.2
4	Modified eau celeste	34 3	33 9	5	5	98.6
5	No treatment	23 11	73 11	9	7	32.4
6	Precipitated carbonate copper solution	32 4	27 15	3	1 5	86.4
7	No treatment	16 2	5 4	5 6	5 8	32.5
8	Copper saccharate	23 3	22 14		5	98.5
9	No treatment	16 15	7 13	5	4 2	46.0
10	Glue mixture	29 14	29 14			100.0
11	No treatment	17 3	3 10	4 4	9 3	21.2
12	Bordeaux mixture	46 4	45 6	8	6	98.0
13	No treatment	17 1	3 13	7 3	6 1	22.1
14	Copper acetate solution	31 13	28 13	2	1	90.4
15	No treatment	33 4	5 5	7 8	20 7	15.9
16	Copper chloride mixture	37 9	36 14	5	6	98.1
17	No treatment	24 12	16 11	3	5 1	67.2
18	Potassium sulphide	19 4	18 6	6	8	95.1
19	No treatment	34 13	22 5	6 3	6 5	64.0
20–21	Sodium hyposulphite	10 9	4 5	3	3 4	40.7
22	No treatment	10 15	7 1	2	1 14	64.3

From the foregoing table we find that the average yield of perfect, part-perfect, and worthless fruit per vine is as follows:

TABLE 7.—*Showing the total average yield, the average yield of perfect, part-perfect, and worthless fruit per vine.*

Plat.	Kind of treatment.	Average yield per vine.	Average yield of perfect fruit.	Average yield of part-perfect fruit.	Average yield of worthless fruit.
		Lbs. Oz.	*Lbs. Oz.*	*Oz.*	*Lbs. Oz.*
2	Ammoniacal solution	2 1	1 14	8	1
3	No treatment	1 4	9	6	4
4	Modified eau celeste	1 11	1 10	2	2
5	No treatment	1 2	6	7	5
6	Precipitated carbonate copper	1 9	1 6	2	1
7	No treatment	12	4	4	4
8	Copper saccharate	1 2	1 2		2
9	No treatment	13	6	4	3
10	Glue mixture	1 7	1 7		0
11	No treatment	13	2	3	7
12	Bordeaux mixture	2 4	2 4	4	3
13	No treatment	13	3	5	4
14	Copper acetate	1 9	1 7	1	8
15	No treatment	1 10	4	6	1 0
16	Copper chloride mixture	1 14	1 13	2	3
17	No treatment	1 3	13	2	4
18	Potassium sulphide solution	15	14	3	4
19	No treatment	1 11	1 1	4	5
20–21	Sodium hyposulphite solution	8	3	2	2
22	No treatment	8	5	1	1

COST OF THE TREATMENTS.

In considering this question, the price of chemicals and the labor in preparing and applying the same, form the basis for the estimates. The wholesale price of the chemicals used was as follows:

Copper carbonate	per pound	$0.35
Copper sulphate, powdered	do	.08
Copper acetate	do	.40
Sodium carbonate	do	.02½
Calcium chloride	do	.05
Aqua ammonia (26°)	do	.08
Glue	per quart	.20
Molasses	do	.10
Lime	per bushel	.30
Potassium sulphide	per pound	.15
Sodium hyposulphite	do	.04

Estimating the labor at 15 cents per hour, the cost of each treatment is shown in the following table:

TABLE 8.—*Showing the cost of each treatment in Vineyard 1.*

Plat.	Kind of treatment.	No. of gals. per plat.	No. of gals. per vine.	Cost of fungicides per plat.	Cost of fungicides per vine.	Cost of labor.	Total cost.
				Cents.	*Cents.*	*Cents.*	*Cents.*
2	Ammoniacal solution	22	1.1	17.5	.9	27	44.5
3	No treatment						
4	Modified eau celeste	22	1.1	6.1	.3	27	33.1
5	No treatment						
6	Precipitated carbonate copper	22	1.1	6.2	.3	27	33.2
7	No treatment						
8	Copper saccharate	22	1.1	9.2	.5	27	36.2
9	No treatment						
10	Glue mixture	22	1.1	8.2	.4	27	35.2
11	No treatment						
12	Bordeaux mixture	22	1.1	6.2	.3	27	33.2
13	No treatment						
14	Copper acetate	22	1.1	1.4	.7	27	28.4
15	No treatment						
16	Copper chloride mixture	22	1.1	5.5	.3	27	32.5
17	No treatment						
18	Potassium sulphide solution	22	1.1	2	.1	27	29
19	No treatment						
20–21	Sodium hyposulphite solution	22	1.1	.7	.35	27	27.7
22	No treatment						

Basing our estimates on the figures in the foregoing table, the cost of treating an acre of 750 vines six times with the various fungicides is as follows:

(1) Ammoniacal solution	$16.50
(2) Modified eau celeste	12.75
(3) Precipitated carbonate copper	12.75
(4) Copper saccharate	13.50
(5) Glue mixture	13.50
(6) Bordeaux mixture	12.75
(7) Copper acetate	10.50
(8) Copper chloride mixture	12.00
(9) Potassium sulphide solution	11.25
(10) Sodium hyposulphite solution	10.50

(2) RESULT OF EXPERIMENTS IN VINEYARD 6.

First treatment (April 27).—Plats 2, 4, 10, and 14 were sprayed at this time. The work on these plats was designed to obtain information upon questions 4 and 5 set forth at the beginning of the article. The condition of the vines, weather, etc., was in every respect the same as described under treatment 1 in Vineyard 1.

Second treatment (May 13).—All plants treated on April 27 were again sprayed. No injury whatever followed the first application. The condition of the vines with respect to growth was the same as noted under second treatment in Vineyard 1.

Third treatment (May 25).—Plats 2, 4, 10, and 14 were again sprayed. The average number of shoots at this time was 40; average length, 19 inches; average size of leaves, 3½ by 4½ inches. Most of the vineyard was in bloom, but these vines were a little backward, not more than half the flowers being open.

Fourth treatment (June 9).—In addition to plats 2, 4, 10, and 14, Nos. 6 and 8 were treated at this time. This, as already pointed out, was to test the effect of Bordeaux mixture, full and half strength, applied when the berries were the size of bird shot. No injury whatever had resulted to foliage, fruit, or wood from previous treatments. In order to obtain information as to the prevalence of rot, each vine was carefully examined, the result being as follows:

TABLE 9.—*Showing the number of vines having their foliage affected with black rot on June 9. (No rot on fruit.)*

Plat.	Kind of treatment.	No. of vines showing black rot.
1	No treatment	3
2	Bordeaux mixture, full strength, early	
3	No treatment	2
4	Bordeaux mixture, half strength, early	
5	No treatment	1
6	Bordeaux mixture, full strength, late	
7	No treatment	2
8	Bordeaux mixture, half strength, late	1
9	No treatment	
10	Bordeaux mixture, full strength, early; 4 sprayings	
11	No treatment	3
12	Bordeaux mixture, full strength, early; 3 sprayings	
13	No treatment	2
14	Bordeaux mixture, half strength, early; 4 sprayings	
15	No treatment	
16	Bordeaux mixture, half strength, early; 3 sprayings	

From the foregoing it appears that 13 of the untreated vines were affected with black rot on June 9, while only 1 of the treated showed the disease. This one received its first spraying on the day the observations were made. The total number of clusters and the average number per vine are shown in the accompanying table.

TABLE 10.—*Showing the total number of clusters on the treated and untreated vines June 9; also the average number of clusters per vine.*

Plat.	Kind of treatment.	Total No. of clusters.	Average No. of clusters per vine.
1	No treatment	364	36.4
2	Bordeaux mixture, full strength, early	206	20.6
3	No treatment	189	18.9
4	Bordeaux mixture, half strength, early	142	14.2
5	No treatment	155	15.5
6	Bordeaux mixture, full strength, late	239	23.9
7	No treatment	155	15.5
8	Bordeaux mixture, half strength, late	175	17.5
9	No treatment	106	10.6
10	Bordeaux mixture, full strength, early, 4 sprayings	93	9.3
11	No treatment	177	17.7
12	Bordeaux mixture, full strength, late, 3 sprayings	109	10.9
13	No treatment	150	15.0
14	Bordeaux mixture, half strength, early, 4 sprayings	98	9.8
15	No treatment	148	14.8
16	Bordeaux mixture, half strength, late, 3 sprayings	165	16.5

As shown by the foregoing the untreated vines contained 1,444 clusters, while the treated gave 1,227 clusters, a difference of 217 clusters, or 15 per cent in favor of the untreated. This may be taken as the normal condition of the vineyard at the time rot made its appearance or when the results of the treatments actually began to show. The greater number of clusters on the untreated vines is accounted for by the fact that as a whole they were larger and more vigorous.

Fifth treatment (June 22).—In accordance with the original plan the treatments on plats 10, 12, 14, and 16 were omitted. Plats 2, 4, 6, and 8 received their regular sprayings. No injury whatever had resulted from any of the previous sprayings. Black rot had made its appearance on the fruit, but not in sufficient amount to produce any serious injury. On the treated vines 62 berries showing rot were found, while on the untreated 96 berries were observed.

Sixth treatment (July 7.)—The plats treated on June 22 were again sprayed for the last time. No injury had resulted from the previous sprayings. Black rot, however, had produced serious injury, especially on the untreated vines. To obtain information as to the actual amount of injury the clusters on all the vines were counted and three divisions made of them as in the case of Vineyard 1. The results of the count are set forth in the accompanying table:

TABLE 11.—*Showing condition of fruit with respect to rot in Vineyard 6, July 7.*

Plat.	Kind of treatment.	Total No. of clusters.	No. of perfect clusters.	No. of part-perfect clusters.	No. of diseased or worthless clusters.	Per cent of perfect clusters.
1	No treatment	256	.....	11	245	.....
2	Bordeaux mixture, full strength, early treatment	189	176	10	3	92
3	No treatment	164	11	9	144	7
4	Bordeaux mixture, half strength, early treatment	138	130	1	7	92
5	No treatment	151	18	17	116	11
6	Bordeaux mixture, full strength, late treatments; 3 sprayings	212	54	68	100	25
7	No treatment	132	4	12	116	3
8	Bordeaux mixture, half strength, late treatments; 3 sprayings	188	78	60	46	41
9	No treatment	75	10	15	50	26
10	Bordeaux mixture, full strength, early treatments; 4 sprayings	93	84	9	.....	90
11	No treatment	142	10	43	89	7
12	Bordeaux mixture, full strength, late treatments; 3 sprayings	109	30	37	42	27
13	No treatment	120	5	23	92	4
14	Bordeaux mixture, half strength, early treatments; 4 sprayings	106	96	9	1	90
15	No treatment	137	5	21	111	3
16	Bordeaux mixture, half strength, late treatments; 3 sprayings	140	36	61	41	25

The very striking results of the experiment are brought out so clearly in the table that little further upon this part of the subject need be said. By comparing the figures of this table with those of the preceding it will be seen, first, that there was an enormous increase of black rot during the month elapsing between June 9 and July 7. The table shows the great importance of early treatment. Another important matter brought out is that there was, so far as preventing rot is concerned, practically no difference between the Bordeaux mixture full and half strength when applied early. The difference between the plats treated with full and half strength four and six times, is certainly not sufficient to pay for the time and trouble in making the additional sprayings.

Arranged in the order of their effectiveness the various treatments stand as follows:

(1) Bordeaux mixture, full strength, early—six sprayings, April 27, May 13, 25, June 9, 22, and July 7 92
(2) Bordeaux mixture, half strength, early—six sprayings, same as 1 91
(3) Bordeaux mixture, full strength, early—four sprayings, April 27, May 13, 22, June 9 91
(4) Bordeaux mixture, half strength, early—four sprayings, same as 3 90
(5) Bordeaux mixture, half strength, late—three sprayings, June 9, 22, and July 7. 41
(6) Bordeaux mixture, half strength, late—three sprayings, same as 5 25

On July 10, three days after the last treatment, a representative cluster was cut from each vine of plats 2, 4, 6, and 8 treated, and plats 5, 7, 11, and 15 untreated. All the rotten berries were removed from these clusters, after which the latter were photographed. The illustrations made from these photographs are shown in Plates I and II.

They represent very fairly the average condition of the various plats on July 10.

From July 7 until September 17, when the fruit was gathered, the vines received no treatment. Following the plan adopted in Vineyard 1 the fruit clusters were counted and weighed, the classification being the same in both cases. In the table below, the total numbers of clusters is first given; then follows the number of perfect, part-perfect, and worthless clusters in the order named; finally, the percentage of perfect clusters is given.

TABLE 12.—*Showing condition of vines in Vineyard 6 with respect to rot on September 17. (Estimates based on a count of the clusters.)*

Plat.	Kind of treatment.	Total No. of clusters.	No. of perfect clusters.	No. of part-perfect clusters.	No. of worthless clusters.	Per cent of perfect clusters.
1	No treatment	237	.....	2	235	.....
2	Bordeaux mixture, full strength, early, 6 sprayings	180	170	8	2	94
3	No treatment	154	7	6	141	4
4	Bordeaux mixture, half strength, early, 6 sprayings	133	125	6	2	93.9
5	No treatment	151	6	5	140	3
6	Bordeaux mixture, full strength, late, 3 sprayings	206	49	54	103	23
7	No treatment	129	.....	.....	129	.....
8	Bordeaux mixture, half strength, late, 3 sprayings	178	23	39	116	12
9	No treatment	72	.....	.....	72	.....
10	Bordeaux mixture, full strength, early, 4 sprayings	92	82	5	5	89
11	No treatment	134	.....	4	130	.....
12	Bordeaux mixture, full strength, late, 3 sprayings	100	20	73	7	20
13	No treatment	93	.....	1	92	.....
14	Bordeaux mixture, half strength, early, 4 sprayings	100	90	4	6	90
15	No treatment	102	1	8	93	.9
16	Bordeaux mixture, half strength, late, 3 sprayings	134	22	8	104	16

A comparison of this table with that on page 28 is very interesting. First, it will be seen that a considerable number of clusters on both the treated and untreated plats disappeared. Second, the number of worthless clusters increased to a considerable extent, especially on the plats receiving the late treatments. Third, and finally, the per cent of perfect fruit on the plats treated early with full and half strength slightly increased, while on most of the other plats there was a decrease. As a final arrangement of the treatments with respect to their efficacy as preventives of rot we have the following, 100 representing perfect:

Bordeaux mixture, full strength, early, six sprayings..... 94
Bordeaux mixture, half strength, early, six sprayings..... 93.9
Bordeaux mixture, half strength, early, four sprayings..... 90
Bordeaux mixture, full strength, early, four sprayings..... 89
Bordeaux mixture, full strength, late, three sprayings..... 23
Bordeaux mixture, half strength, late, three sprayings..... 16

Turning now to the weight of the fruit on the various plats we have the figures set forth in the table below:

TABLE 13.—*Showing the total weight of fruit from each plat in Vineyard 6; also the weight of perfect, part-perfect, and worthless fruit and the percentage of perfect fruit.*

Plat.	Kind of treatment.	Total weight of fruit.	Weight of perfect fruit.	Weight of part-perfect fruit.	Weight of worthless fruit.	Per cent of perfect fruit.
		Lbs. Oz.	*Lbs. Oz.*	*Lbs. Oz.*	*Lbs. Oz.*	
1	No treatment	2 6		4	2 2	
2	Bordeaux mixture, full strength, early, 6 sprayings	21 15	20 9.9	1 6		94
3	No treatment	2 7	1.7	3	2 3	4.54
4	Bordeaux mixture, half strength, early, 6 sprayings	20 6	19 8	10 4		93
5	No treatment	2 15	1.4	12	2 2	3
6	Bordeaux mixture, full strength, late, 3 sprayings	11 6	2 11	6 3	2 8	24
7	No treatment	1 4			1 4	
8	Bordeaux mixture, half strength, late, 3 sprayings	8 14	15.6		2 7	11
9	No treatment	1			1	
10	Bordeaux mixture, full strength, early, 4 sprayings	8	7 2	9	5	89
11	No treatment	1 11		3	1 8	
12	Bordeaux mixture, full strength, late, 3 sprayings	6 5	1 5	4 10	6	21
13	No treatment	1 3		1	1 2	
14	Bordeaux mixture, half strength, early, 4 sprayings	1 4	2		4	90
15	No treatment	2 2	.3	1 1	1 1	.98
16	Bordeaux mixture, half strength, late, 3 sprayings	2 15	7	1 2	1 6	16

COST OF THE TREATMENTS.

In the accompanying table full details as regards the cost of the treatments are given.

TABLE 14.—*Showing cost of treatments in Vineyard 6.*

Plat.	Kind of treatment.	No. of gallons per plat.	No. of gallons per vine.	Cost of fungicide per plat.	Cost of fungicide per vine.	Cost of labor per plat.	Cost of labor per vine.	Total cost.	Cost per acre (750 vines).
				Cents.	*Cents.*	*Cents.*	*Cents.*	*Cents.*	
1	No treatment								
2	Bordeaux mixture, full strength, early, 6 sprayings	11	1.1	27.5	2.7	13	1.3	40.5	$30.00
3	No treatment								
4	Bordeaux mixture, half strength, early, 6 sprayings	11	1.1	13.7	1.3	13	1.3	26.7	19.50
5	No treatment								
6	Bordeaux mixture, full strength, late, 3 sprayings	6	.6	15	1.5	6.5	.7	21.5	16.50
7	No treatment								
8	Bordeaux mixture, half strength, late, 3 sprayings	6	.6	7.5	.7	6.5	.7	14.0	10.50
9	No treatment								
10	Bordeaux mixture, full strength, early, 4 sprayings	7	.7	17.5	1.7	7	.7	24.5	18.00
11	No treatment								
12	Bordeaux mixture, full strength, late, 3 sprayings	6	.6	15	1.5	6.5	.7	21.5	16.50
13	No treatment								
14	Bordeaux mixture, half strength, early, 4 sprayings	7	.7	8.8	.8	7	.7	15.8	11.25
15	No treatment								
16	Bordeaux mixture, half strength, late, 3 sprayings	6	.6	7.5	.7	6.5	.7	14.0	10.50

It must be borne in mind that these figures are far in excess of what the work would cost in spraying an acre or more. When considering the matter from this standpoint it will be fair to make the estimates fully 50 per cent less. Thus the cost of treating a vineyard six times with Bordeaux mixture, full strength, need not exceed $15 per acre. Using half strength the cost would be reduced to $10 per acre.

CONCLUSIONS.

(1) With the exception of the Bordeaux mixture all of the fungicides used in Vineyard 6 more or less injured both leaves and fruit.

(2) This injury, while more than offset by the protection of the fruit from rot, is to be looked upon as a serious drawback to the use of the preparations.

(3) The preparations, however, are all worthy of further trial, as it may be possible by a modification of the formulæ to largely overcome the difficulties set forth under 1.

(4) In the prevention of black rot all the preparations gave good results, the average for the copper preparations being higher than that of the solutions containing none of this metal.

(5) Taking cost, ease of preparation and application, effect on foliage and fruit, and all other questions into consideration, the Bordeaux mixture, even though reduced to less than one-sixth the usual strength, proved the most reliable remedy against rot.

(6) In Vineyard 6 Bordeaux mixture, half strength, gave practically as good results as the same preparation full strength.

(7) In every case early treatments gave decidedly better results than late ones.

(8) Six treatments, the last two after the grapes were practically grown, gave little better results than four, the last being made when the berries were the size of bird shot.

EXPERIMENTS IN THE TREATMENT OF APPLE SCAB IN WISCONSIN.

This work, as in the two preceding years, was carried on by Prof. E. S. Goff, of the State Experiment Station at Madison. The orchard of Mr. A. L. Hatch, near Ithaca, was again selected for the work, partly on account of its location in a large apple-growing region and partly because the necessary trees could not well be obtained near Madison.

The experiment was designed to obtain information on the following questions:

(1) The effect of one winter treatment on scab.

(2) The effect of one winter and one early spring treatment on the disease.

(3) The effect of one winter treatment and three sprayings after the falling of the petals.

(4) The effect of one early spring treatment and three sprayings after the petals dropped.

(5) The effect on scab and insects of one line of treatment.

(6) The comparative value of the following preparations as preventives of scab and as remedies against scab and insects:

(*a*) Ammoniacal solution of copper carbonate made by mixing 1 ounce of copper carbonate and 6 ounces of ammonium carbonate, and then dissolving in 10 gallons of water.

(*b*) Copper carbonate in suspension made by mixing 1 pound of copper carbonate in 100 gallons of water.

(*c*) Simple solution of copper sulphate made by dissolving 1 pound of copper sulphate in 25 gallons of water.

(*d*) Bordeaux mixture prepared in the usual way, with 6 pounds of copper sulphate and 4 pounds of lime to 22 gallons of water.

(*e*) Paris green solution prepared by mixing 1 pound of Paris green with 200 gallons of water in which enough lime had been stirred to give it a slightly milky appearance.

(*f*) Kerosene emulsion made in the usual way with soap* and diluted at the rate of 12½ gallons of the emulsion to 100 gallons of water; also kerosene in an intimate mechanical mixture made by pumping the kerosene and water together by means of a specially constructed pump.†

(*g*) London purple combined with the ammoniacal copper carbonate solution at the rate of 1 pound to 200 gallons of water for the first treatment, after which the quantity of purple was reduced one-half.

(*h*) One pound of London purple combined with 100 gallons of copper carbonate suspended in water.

(*i*) London purple combined with Bordeaux mixture at the rate of 1 pound to 100 gallons of water.

The trees selected for the work were of the Haas or Fall Queen variety. They were of medium size and gave promise of a good crop of fruit. The following table gives in detail the manner of treating, the dates of the same, and the number of applications made:

TABLE 15.—*Showing the manner, number, and dates of treatment for apple scab.*

ONE WINTER TREATMENT.

Tree No.	Times sprayed.	Sprayed with—	Date when sprayed.
1–2	1	Ammoniacal copper carbonate, London purple	March 23.
3–4	1	Suspended copper carbonate, London purple	Do.
5–6	1	Bordeaux mixture, London purple	Do.
7–8	1	Copper sulphate	Do.
9–10	1	Copper sulphate, kerosene	Do.

* The formula is as follows: Kerosene, 2 gallons; common soap or whale-oil soap, one-half pound; water, 1 gallon. Heat the solution of soap and add it boiling hot to the kerosene; churn the mixture by means of a force pump and spray nozzle for five or ten minutes. (See Farmer's Bulletin No. 7, pp. 6–7.

† For description see the Eighth Annual Report of the Wisconsin Experiment Station, 1891, p. 162.

ONE WINTER AND ONE SPRING TREATMENT.

TABLE 15.—*Showing the manner, number, and dates of treatment for apple scab*—Cont'd.

Tree No.	Times sprayed.	Sprayed with—	Date when sprayed.
11–12	2	Ammoniacal copper carbonate, London purple	Mar. 23, May 1.
13–14	2	Suspended copper carbonate, London purple	Do.
15–16	2	Bordeaux mixture, London purple	Do.
		ONE SPRING AND THREE SUMMER TREATMENTS.	
17–18	4	Ammoniacal copper carbonate, London purple	May 1, June 15, June 26, July 14.
19–20	4	Suspended copper carbonate, London purple	Do.
21–22	4	Bordeaux mixture, London purple	Do.
		ONE WINTER AND THREE SUMMER TREATMENTS.	
23–24	4	Kerosene and London purple	March 23, June 15, June 26, July 14.
25–26	4	Paris green	Do.
		ONE WINTER, ONE SPRING, AND THREE SUMMER TREATMENTS.	
27–28	5	Ammoniacal copper carbonate, London purple	March 23, May 1, June 15, June 26, July 14.
29–30	5	Suspended copper carbonate, London purple	Do.
31–32	5	Bordeaux mixture, London purple	Do.
		CHECK—NOT TREATED.	
33–34			

A severe drought prevailed during the months of August and September, causing the apples to mature earlier than usual. The early part of the season was also exceptionally dry, in consequence of which very little scab developed.

On September 10 to 12, inclusive, the entire crop from all the trees constituting the experiment was gathered and sorted into three qualities with reference to the amount of scab, as follows:

First quality: Fruits absolutely free from scab.

Second quality: Fruits showing scab spots, but not of sufficient size or number to distort the apples.

Third quality: Fruits more affected.

The data relating to the experiment are chiefly grouped in the following table. To render the data more intelligible, the average results of the two duplicate trees submitted to each treatment are graphically illustrated in Plate III.

TABLE 16.—*Showing result of treatment for apple scab in quality of fruit.*

Tree number.	Number of fruits.	Per cent of fruits in—			Average for the two trees; per cent of fruits in—			Per cent of wormy fruits.
		First quality.	Second quality.	Third quality.	First quality.	Second quality.	Third quality.	
1	734	31.61	63.62	4.77				
2	958	29.54	66.81	3.65	30.43	65.42	4.15	
3	410	30.00	66.83	3.17				1.95
4	63	28.57	68.25	3.18	29.81	67.02	3.17	
5	885	25.76	69.60	4.64				8.70
6	91	21.98	68.13	9.89	25.41	69.46	5.13	
7	857	35.01	62.89	2.10				4.90
8	278	38.49	57.19	4.32	35.86	61.50	2.64	4.68
9	843	28.71	65.24	6.05				9.96
10	382	29.06	59.95	10.99	28.82	63.59	7.59	
11	512	22.46	73.44	4.10				
12	1,331	29.15	67.84	3.01	27.24	69.40	3.36	
13	612	31.37	65.69	2.94				4.25
14	39	31.28	48.72		32.56	64.67	2.77	
15	1,114	39.25	59.97	.78				6.38
16	623	37.56	60.35	2.09	38.65	60.10	1.25	7.70
17	115	16.52	80.00	3.48				8.69
18	40	12.50	75.00	12.50	15.48	78.71	5.81	2.50
19	217	35.02	61.29	3.69				
20	34	41.18	50.00	8.82	35.86	59.76	4.38	
21	619	33.60	65.10	1.30				6.30
22	192	33.85	60.94	5.21	33.66	64.16	2.18	
23	608	35.36	62.83	1.81				7.89
24	258	34.11	62.40	3.49	34.99	62.70	2.31	6.97
25	1,526	55.64	43.84	.52				.98
26	541	49.17	48.61	2.22	53.94	45.09	.97	74
27	925	28.65	68.76	2.59				9.46
28	470	14.89	75.74	9.37	24.01	71.11	4.88	12.34
29	841	36.86	60.52	2.62				
30	110	37.27	57.27	5.46	30.91	60.15	2.94	
31	1,239	48.43	50.77	.80				6.92
32	80	35.00	62.50	2.50	47.60	51.48	.92	
33	45	13.33	82.22	4.45				
34	827	30.93	66.75	2.32	30.05	67.55	2.40	6.77

COMMENTS ON THE RESULT OF THE EXPERIMENT.

Under this head Prof. Goff reports as follows:

Considering the small amount of scab and the variation in trees treated alike, few deductions are warrantable. Of the materials used in the winter treatment copper sulphate appears to have been in some degree beneficial. Bordeaux mixture, which was apparently useless in the winter, appears to have been beneficial in the spring and summer treatments. There are no indications that the ammoniacal solution of copper carbonate, that gave such excellent results in 1889, was beneficial in any case the past season. This fungicide was prepared by a different method from the one previously used, but it seems hardly probable that this could account for its apparent lack of efficiency. Copper carbonate in suspension, however, appears to have been beneficial in the spring and summer treatments, though in less degree than the Bordeaux mixture.

It is interesting to note that the most marked results were secured from the use of Paris green alone. It was suggested that this material, being a compound of copper, might possess valuable properties as a fungicide, and the trial of the past season indicates that such may be the case.

In order to give a more satisfactory comparison of the merits of copper carbonate in the two methods used and the Bordeaux mixture, the percentages of the fruits in the three qualities, respectively, were computed upon the total number of fruits from the eight trees sprayed with each of these preparations. This gives a total of 5,085 fruits sprayed with the ammoniacal copper carbonate, 2,326 with the suspended copper carbonate, and 4,873 with the Bordeaux mixture. Being based on so large a number of fruits, these results may be regarded as more reliable than those cal-

culated on the crop of but two trees. The percentages of fruit in the different qualities were as follows:

	First quality.	Second quality.	Third quality.
	Per cent.	*Per cent.*	*Per cent.*
Ammoniacal copper carbonate	27.08	68.83	4.09
Suspended copper carbonate	34.14	62.77	3.09
Bordeaux mixture	37.59	60.31	2.10

These results, which also appear in Fig. 6 of Plate III serve to confirm the deductions already made.

There were no indications that the London purple or the kerosene emulsion had any effect in reducing injury from the codling moth. The sample of London purple used may have been of inferior quality, as Mr. Hatch found it nearly ineffectual against leaf rollers and the tent caterpillar, even when used at the rate of a pound to fifty gallons of water. The Paris green, however, proved almost a complete preventive of injury from the codling moth, as appears from the numerical table. It was hoped that the winter application might destroy the winter eggs of the apple aphis, but there were no indications that it had any effect upon them.

The computations of the cost of the treatments in the experiments of 1889 and 1890 were based on an expenditure of three gallons of each preparation in spraying one tree; but the experience of Mr. Hatch in spraying his entire orchard shows conclusively that this estimate is unduly large, and that in practical fieldwork, 1 to 1½ gallons are sufficient to cover a tree of average size. The estimates of cost in this report are therefore made on the basis of 1½ gallons of liquid per treatment for one tree. An expenditure for labor of 5 cents per tree for each treatment is probably more nearly correct, on the basis of practical fieldwork, than the allowance heretofore made for this purpose. The cost of one treatment for one tree with each of the materials used, including the labor of preparation, would not vary much from the following:

	Cost of spraying liquid.	Cost of London purple.	Labor of application.	Total cost.
Ammoniacal copper carbonate	$0.026	$0.0015	$0.05	$0.0775
Suspended copper carbonate	.029	.0015	.05	.0805
Bordeaux mixture	.06	.0015	.05	.1115
Paris green	.008		.05	.058
Copper sulphate	.010		.05	.0604
Copper sulphate with kerosene	.03915		.05	.08915
Kerosene emulsion	.03375	.0015	.05	.08525

These estimates assume copper carbonate worth $0.40 per pound; ammonium carbonate, $0.25; copper sulphate, $0.09; lime, $0.01; Paris green, $0.40; London purple, $0.10, and kerosene, $0.10 per gallon. The labor of preparing the kerosene emulsion was estimated at $0.015 per gallon; that of the Bordeaux mixture, and ammoniacal copper carbonate $0.01, and that of the suspended copper carbonate, copper sulphate, and Paris green, $0.005 per gallon.

CONCLUSIONS.

From Prof. Goff's work the following conclusions may be drawn:

(1) One treatment with simple solution of copper sulphate in spring before growth started reduced the amount of scab to a noticeable extent.

(2) The ammoniacal solution of copper carbonate as used in this work was less effective against scab than copper carbonate suspended in water.

(3) The Bordeaux mixture was more effective in the experiment than either form of the carbonate of copper.

(4) Paris green was more efficient in preventing scab and more effective against insects than any of the other preparations used singly or combined.

EXPERIMENTS IN THE TREATMENT OF PEAR LEAF-BLIGHT, CRACKING, AND SCAB.

These experiments were carried on in the orchard of Dr. W. S. Maxwell, near Still Pond, Md. In the main the work was designed to throw light on the following questions:

(1) A comparison of eight fungicides, each depositing on the foliage the same amount of the compound of copper as the ammoniacal carbonate of copper solution; (*a*) as preventives of leaf-blight, cracking, and scab; (*b*) as regards their effect on the healthy wood, leaves, flowers, and fruit, and (*c*) as regards cost.

(2) A comparison of two fungicides, containing no copper, with the foregoing preparations.

(3) The effect on leaf-blight, scab, and cracking of two treatments, one when the flowers were opening and one when the petals were falling.

(4) The effect of three treatments, the first before the flower buds opened, the second just as the petals expanded, and the third when the petals were falling.

(5) A comparison of seven treatments with the foregoing, the first three given at the same time as those in 4, and the others at intervals of two to three weeks up to the time the fruit was two-thirds grown.

The fungicides used were exactly the same as those employed in the treatment of black rot of the grape. (See *ante*, pp. 10–11.) The list is as follows:

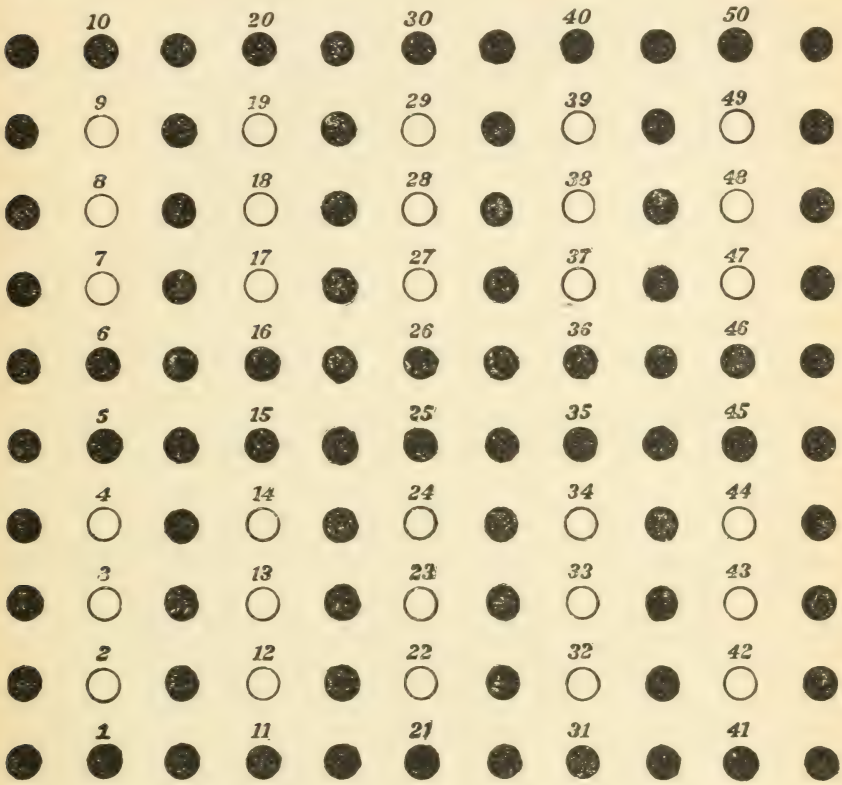
(1) Ammoniacal solution of copper carbonate.
(2) Modified eau celeste.
(3) Precipitated carbonate of copper solution.
(4) Copper saccharate.
(5) Glue mixture.
(6) Bordeaux mixture.
(7) Copper acetate.
(8) Copper chloride mixture.
(9) Potassium sulphide solution.
(10) Sodium hyposulphite solution.

The manner of preparing the foregoing is set forth in the chapter on experiments in the treatment of grape diseases.

A block of Duchess dwarf trees situated near the center of a large orchard was selected for the work. The block contained 111 trees,

planted 10 by 12 feet. The trees were fairly uniform in size, the average height being about 10 feet. Thirty of the trees were treated, while the rest were left for control. In the following diagram and explanation thereto, the plan of the experiment is shown.

DIAGRAM 6.—*Plan of experiment in the treatment of pear leaf-blight, cracking, and scab. Each tree is represented by a circle, the black being the untreated, the white the treated.*



EXPLANATION OF DIAGRAM NO. 6.

Tree.	Kind of treatment.	Date of sprayings.
1	No treatment	
2	Ammoniacal solution, two treatments	April 25, May 9.
3	Ammoniacal solution, three treatments	April 14, 25, May 9.
4	Ammoniacal solution, seven treatments	April 14, 25, May 9, June 5, 25, July 15, August 5.
5	No treatment	
6	No treatment	
7	Modified eau celeste, two treatments	April 25, May 9.
8	Modified eau celeste, three treatments	April 14, 25, May 9.
9	Modified eau celeste, seven treatments	April 14, 25, May 9, June 5, 25, July 15, August 5.
10	No treatment	
11	No treatment	
12	Precipitated carb. copper, two treatments	April 25, May 9.
13	Precipitated carb. copper, three treatments	April 14, 25, May 9.
14	Precipitated carb. copper, seven treatments	April 14, 25, May 9, June 5, 25, July 15, August 5.

Explanation of diagram No. 6—Continued.

Tree.	Kind of treatment.	Date of spraying.
15	No treatment	
16	No treatment	
17	Copper saccharate, two treatments	April 25, May 9.
18	Copper saccharate, three treatments	April 14, 25, May 9.
19	Copper saccharate, seven treatments	April 14, 25, May 9, June 5, 25, July 15, August 5.
20	No treatment	
21	No treatment	
22	Glue mixture, two treatments	April 25, May 9.
23	Glue mixture, three treatments	April 14, 25, May 9.
24	Glue mixture, seven treatments	April 14, 25, May 9, June 5, 25, July 15, August 5.
25	No treatment	
26	No treatment	
27	Bordeaux mixture, two treatments	April 25, May 9.
28	Bordeaux mixture, three treatments	April 14, 25, May 9.
29	Bordeaux mixture, seven treatments	April 14, 25, May 9, June 5, 25, July 15, August 5.
30	No treatment	
31	No treatment	
32	Copper acetate, two treatments	April 25, May 9.
33	Copper acetate, three treatments	April 14, 25, May 9.
34	Copper acetate, seven treatments	April 14, 25, May 9, June 5, 25, July 15, August 5.
35	No treatment	
36	No treatment	
37	Copper chloride mixture, two treatments	April 25, May 9.
38	Copper chloride mixture, three treatments	April 14, 25, May 9.
39	Copper chloride mixture, seven treatments	April 14, 25, May 9, June 5, 25, July 15, August 5.
40	No treatment	
41	No treatment	
42	Potassium sulphide solution, two treatments	April 25, May 9.
43	Potassium sulphide solution, three treatments	April 14, 25, May 9.
44	Potassium sulphide solution, seven treatments	April 14, 25, May 9, June 5, 25, July 15, August 5.
45	No treatment	
46	No treatment	
47	Sodium hyposulphite solution, two treatments	April 25, May 9.
48	Sodium hyposulphite solution, three treatments	April 14, 25, May 9.
49	Sodium hyposulphite solution, seven treatments	April 14, 25, May 9, June 5, 25, July 15, August 5.
50	No treatment	

Believing that the foregoing clearly sets forth the plan of the experiment, the work will now be taken up in detail.

First treatment (April 14).—Two trees in each plat were sprayed with each of the ten fungicides, a Nixon Little Giant force pump provided with Vermorel nozzle being used for the purpose. The flower buds were not open and only a few leaves had started. Heavy rains had fallen previous to the spraying, making it difficult to move the spraying machine about. No scab or leaf-blight whatever was observed. Most of the trees gave promise of an excellent crop, flower buds being very abundant.

Second treatment (April 25).—The two trees in each plat were again sprayed at this time, and in addition a third tree in each plat received its first spraying. Owing to the small quantity of fungicide used, the Galloway knapsack pump was substituted for the Nixon cart machine. This pump, which was provided with a Vermorel nozzle having a lance 4 feet long, did its work well, the tops of all the trees being easily reached.

At this time the leaves were about one-third grown and the flowers had for the most part disappeared. No rain of consequence had fallen

since the last treatment, and as a result the ground was quite dry. All the trees were showing the leaf-blight fungus to a limited extent. No difference in this respect between the treated and untreated trees was observed. Many of the flowers still on the trees, as well as young fruits of both treated and untreated trees, were affected with a disease which appeared to be different from that caused by *Entomosporium*. The petals showed here and there brown spots resembling those sometimes occasioned by the pear-blight germ. Where a badly diseased petal remained attached to a young fruit, a brown or black spot had made its appearance on the latter. Frequently the entire fruit, as well as the stalk supporting it, was found badly diseased. Whole clusters of flowers and young fruit were affected in this way, those near the ground and in the center of the tree being injured the most. Microscopic examination revealed the fact that the disease was due to *Sphæropsis malorum*, a fungus which attacks a number of pomaceous fruits. The life history of this fungus is now being studied, and when the work is completed the results will be made the subject of a special paper to be published in the Journal of Mycology.

Third treatment (May 9).—All the trees in the treated plats were sprayed at this time, the fruit being slightly larger than No. 1 buckshot. Leaf-blight and scab were found in small quantities on both the treated and untreated trees. Careful examination revealed the fact that a number of the fungicides had caused the young fruit to assume a brownish color. This was especially noticeable around the slight depression at the free ends of the pears. At these points the skin had a rusty appearance, and when rubbed would frequently fall away in small flakes. The greater injury at the points mentioned was no doubt due to the fact that the fungicides had accumulated in the slight depressions while the young fruit was yet erect.

Fourth treatment (June 5).—This was really the date for the fifth treatment, but owing to the injury resulting from the third spraying all treatments were omitted at the date set for the fourth spraying. The trees which were sprayed on April 25 and May 9 received no treatment at this time, the plan being, as indicated in Diagram 6, for them to receive only two treatments. The trees sprayed with Bordeaux mixture were found to be very severely injured, the leaves in many cases being blackened and the fruit spotted and blistered. Except for the slight browning of the fruit, none of the other treatments had proven injurious. The injury following the use of the Bordeaux mixture was due in a large part to the use of air-slaked instead of fresh lime. In addition to this, very little rain fell between the time of the first and third sprayings, thus allowing the mixture to accumulate on the fruit. When the rain came there was a large amount of free copper sulphate present, and in consequence the fruit and foliage were burned.

To obtain some definite information on this point two large pear trees were selected and half of one was sprayed with Bordeaux mixture containing 4 pounds of air-slaked lime and 6 pounds of copper sulphate to 22 gallons of water. The other half was sprayed with Bordeaux mixture containing 6 pounds of air-slaked lime and 6 pounds of copper sulphate to 22 gallons of water. The remaining tree was sprayed with a mixture made with 4 pounds of fresh lime, 6 pounds of sulphate of copper, and 22 gallons of water. In ten days the half of tree 1 sprayed with Bordeaux mixture containing only 4 pounds of air-slaked lime was seriously injured, the leaves and fruit being spotted and blistered like those in the experimental plats. The half of the tree sprayed with the mixture containing 6 pounds of air-slaked lime and the entire tree treated with Bordeaux mixture made with fresh lime showed no injury whatever. This shows the importance of always using fresh lime, as it is very difficult to determine the exact amount of air-slaked lime to use, owing to the varying quality of this substance. A simple method of testing the mixture for free copper is now frequently resorted to when we are in doubt as to whether enough lime has been added.* One-half ounce of ferrocyanide of potassium is dissolved in 2 or 3 ounces of water, placed in a bottle, and kept corked. When it is desired to test a fungicide for free copper a few drops of this solution is added. The least quantity of free copper immediately gives a brownish reaction. If there be no reaction when the ferrocyanide solution is added, it is safe to say that the solution tested contains practically no free copper.

For the purpose of obtaining some definite information as regards injury to the foliage and fruit resulting from the treatments, all the trees were carefully examined. In considering this matter the burning caused by the Bordeaux mixture is omitted, for the reason that, had this preparation been properly made, the damage would not have resulted. In Diagram 7 is shown graphically the results of the observations made at this time.

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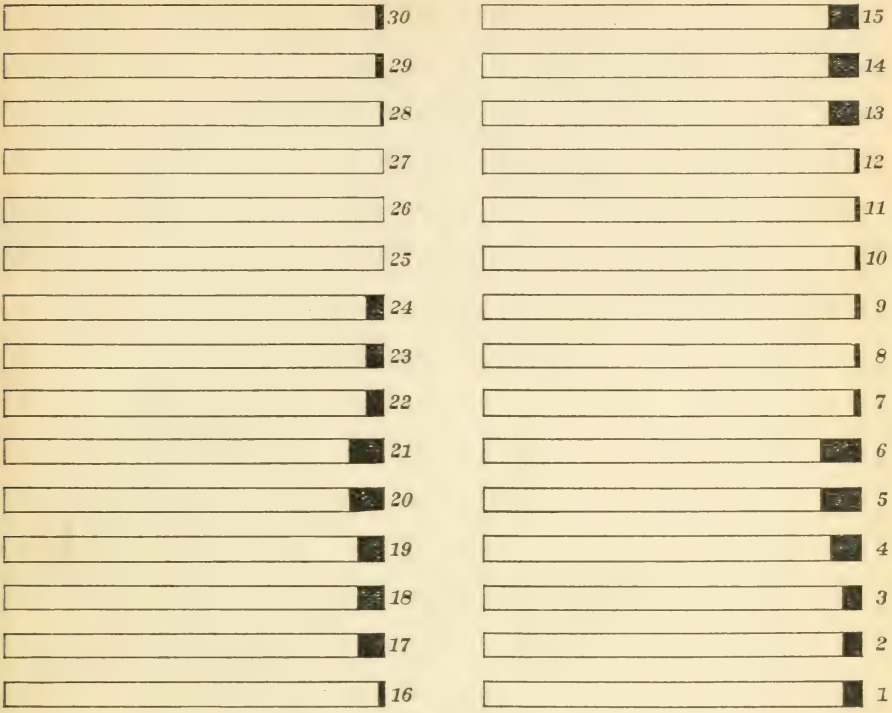
*First proposed by Dr. G. Patngeou in Prog. Agric. et Viticol.

DIAGRAM 7.—*Injury to foliage and fruit as a result of treatments. Black indicates injury; white, freedom from it.*



EXPLANATION OF DIAGRAM NO. 7.

Tree.	Kind of treatment.	No. of treatments.
1	Ammoniacal solution	2
2	ditto	3
3	ditto	7
4	Modified eau celeste	2
5	ditto	3
6	ditto	7
7	Precipitated carbonate of copper solution	2
8	ditto	3
9	ditto	7
10	Copper saccharate	2
11	ditto	3
12	ditto	7
13	Glue mixture	2
14	ditto	3
15	ditto	7
16	Bordeaux mixture	2
17	ditto	3
18	ditto	7
19	Copper acetate	2
20	ditto	3
21	ditto	7
22	Copper chloride mixture	2
23	ditto	3
24	ditto	7
25	Potassium sulphide solution	2
26	ditto	3
27	ditto	7
28	Sodium hyposulphite	2
29	ditto	3
30	ditto	7

The results are so plainly set forth in the diagram that comment is unnecessary.

Fifth treatment (June 25).—Only the trees which were to receive seven sprayings were treated at this time, the work on the others being completed. No decided change, as regards injury, from the treatments took place since the last spraying. All the trees showed more or less of the *Entomosporium* and scab fungus, but it was too early to form any definite opinion as regards the effects of the treatments.

Sixth treatment (July 15).—Aside from the fact that the rusty appearance of the fruit had increased on all of the treated trees, very little change took place between this spraying and the last. The effects of the *Entomosporium* and scab fungus were becoming more apparent, in consequence of which it was decided to examine all the fruit at the next spraying, for the purpose of obtaining information on the results of the treatments.

Seventh treatment (August 15).—The seventh and last treatment was made immediately after a heavy rain. The orchard, as a whole, at this time was in fair condition. *Entomosporium* had caused many of the leaves on the untreated trees to fall. This fungus also occurred to a considerable extent on the fruit. Scab was not very abundant, certainly not to the same extent as the *Entomosporium*. To obtain information as regards the result of this work, the fruit on each tree was counted and the following points noted:

(1) Total number of fruits.

(2) Total number affected with scab.

(3) Total number affected with *Entomosporium*.

The figures obtained by this count enabled us to determine the percentage of fruit affected with *Entomosporium* and the percentage affected with scab. In making the count, some fruits were found affected with both *Entomosporium* and scab. In such cases, if the specimen showed a greater amount of scab than *Entomosporium* it was referred to the former class. If, on the other hand, *Entomosporium* predominated, it was classified as being affected with this fungus.

The effects of *Entomosporium* and scab on the foliage were also observed. Finally, careful observations were made on each tree for the purpose of determining the injurous effects, if any, of the treatments. In the table below (Table 17) the results of the count made to determine the total number of fruits, the number affected with scab, the number affected with *Entomosporium*, and the percentage in each case, are given in detail.

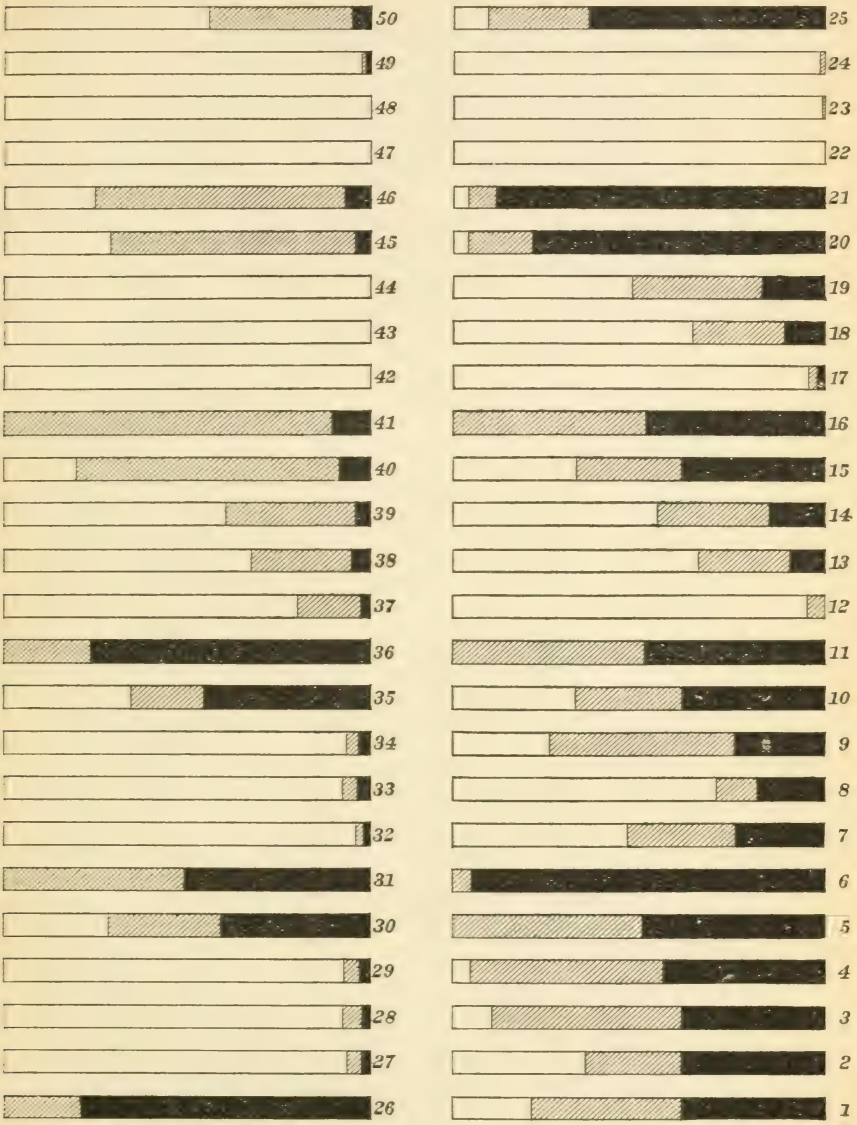
TABLE 17.—*Showing total number of fruits, number affected with scab and Entomosporium, and percentages.*

Tree.	Kind of treatment.	Date of treatment.	Total number of fruits.	Number of scabby fruits.	Number affected with Entomosporium.	Per cent scabby.	Per cent affected with Entomosporium.
1	No treatment		140	6	52	4.44	37.14
2	Ammoniacal solution	Apr. 25, May 9	210	4	4	1.9	1.90
3	ditto	Apr. 14, 25, May 9	110	2		1.81	
4	ditto	Apr. 14, 25, May 9, June 5, 25, July 15, and Aug. 5.	108	1		.92	
5	No treatment		136	3	46	2.20	33.82
6	ditto		88	8	32	9.09	36.36
7	Modified eau celeste	Apr. 25, May 9	248	3	7	1.21	2.82
8	ditto	Apr. 14, 25, May 9	106	1	3	.94	2.83
9	ditto	Apr. 14, 25, May 9, June 5, 25, July 15, and Aug. 5.	87		2		2.29
10	No treatment		116	9	70	7.75	60.34
11	ditto		143	8	86	5.59	60.13
12	Precipitated carbonate of copper solution.	Apr. 25, May 9	106	4	18	3.77	16.98
13	ditto	Apr. 14, 25, May 9	164	5	24	3.04	14.63
14	ditto	Apr. 14, 25, May 9, June 5, 25, July 15, and Aug. 5.	194	4	2	2.06	1.03
15	No treatment		46	2	36	4.34	78.26
16	ditto		87	6	42	6.89	48.27
17	Copper saccharate solution.	Apr. 25, May 9	162	4	20	2.46	12.34
18	ditto	Apr. 14, 25, May 9	52		6		11.53
19	ditto	Apr. 14, 25, May 9, June 5, 25, July 15, and Aug. 5.	134				
20	No treatment		118	4	64	3.38	54.23
21	ditto		92	6	70	6.52	76.08
22	Glue mixture	Apr. 25, May 9	110	1	5	.90	4.54
23	ditto	Apr. 14, 25, May 9	63		15		23.80
24	ditto	Apr. 14, 25, May 9, June 5, 25, July 15, and Aug. 5.	66		1		1.51
25	No treatment		164	5	130	3.04	79.26
26	ditto		116	7	84	6.03	72.41
27	Bordeaux mixture	Apr. 25, May 9	63	2	2	3.17	3.17
28	ditto	Apr. 14, 25, May 9	28	1	1	3.57	3.57
29	ditto	Apr. 14, 25, May 9, June 5, 25, July 15, and Aug. 5.	17				
30	No treatment		130	4	120	3.07	92.30
31	ditto		118	7	98	5.93	83.05
32	Copper acetate	Apr. 25, May 9	264	6	118	2.27	44.69
33	ditto	Apr. 14, 25, May 9	218	3	75	1.37	34.40
34	ditto	Apr. 14, 25, May 9, June 5, 25, July 15, and Aug. 5.	85	3	12	3.52	14.11
35	No treatment		126	3	65	2.38	51.58
36	ditto		48	7	35	14.58	72.91
37	Copper chloride mixture	Apr. 25, May 9	172	4	122	2.32	70.93
38	ditto	Apr. 14, 25, May 9	82		62		75.60
39	ditto	Apr. 14, 25, May 9, June 5, 25, July 15, and Aug. 5.	263	3	5	1.14	1.90
40	No treatment		147	5	89	3.40	60.54
41	ditto		246	5	218	2.03	88.61
42	Potassium sulphide solution.	Apr. 25, May 9	57	4	37	7.01	64.91
43	ditto	Apr. 14, 25, May 9	72	2	18	2.77	25
44	ditto	Apr. 14, 25, May 9, June 5, 25, July 15, and Aug. 5.	52	3	8	5.76	15.38
45	No treatment		53	3	50	5.66	94.33
46	ditto		110	4	68	3.63	61.81
47	Sodium hyposulphite solution.	Apr. 25, May 9	127	4	106	3.14	83.45
48	ditto	Apr. 14, 25, May 9	104	5	64	4.80	61.53
49	ditto	Apr. 14, 25, May 9, June 5, 25, July 15, and Aug. 5.	134	5	104	3.64	77.61
50	No treatment		127	8	106	6.29	83.46

Little comment upon this table is necessary, as the facts it sets forth speak for themselves. The most striking results are brought out in the last column, where the percentage of fruit affected with *Entomosporium* is shown. It will be seen that the amount of fruit affected with this fungus varies from 30 to 95 per cent on the untreated trees, while on the plats treated with the copper preparations the greatest amount was 25 per cent.

The condition of the foliage on the treated and untreated trees with respect to the leaf-blight is shown in Diagram 8. In preparing this diagram two points were considered, namely: (*a*) Condition of the foliage remaining on the tree with respect to *Entomosporium*; and (*b*) condition of the trees as a whole as regards the amount of foliage still on them; or, what is the same thing, the amount of foliage which had already fallen through the attacks of the fungus.

DIAGRAM 8.—*Showing the condition of the foliage on the treated and untreated trees, August 5, with respect to leaf-blight. Black represents defoliation; lines represent leaves affected with leaf-blight; white, leaves free from leaf-blight. (For numbers see explanation of Diagram 6.)*



The condition of the trees with respect to injury had, so far as could be ascertained, changed but little since the fourth spraying. Diagram 7, which shows the injury fairly well, represented the condition of the trees in this respect on August 5.

THE COST OF THE TREATMENTS.

In an experiment of this kind the question of cost is only to be looked upon as valuable from a relative point of view. It is safe to say that in places where spraying is conducted on a large scale the cost of the work would be nearly 50 per cent less than what our figures indicate. The figures given in the table below are based upon the same estimates for chemicals and labor used in the grape experiment.

TABLE 18.—*Cost of the various treatments made at Still Pond, Md., for pear leaf-blight, scab, and cracking.*

Tree.	No. of treatments.	Kind of treatment.	Fungicide used.	Cost of fungicide.	Cost of labor.	Total cost.
			Gallons.	*Cents.*	*Cents.*	*Cents.*
1	2	Ammoniacal solution	2.58	2.0	2.7	4.7
2	3	ditto	3.58	2.8	4.1	6.9
3	7	ditto	6.58	5.1	9.6	14.8
4	2	Modified eau celeste	2.25	.6	2.7	3.3
5	3	ditto	3.25	.8	4.1	5.0
6	7	ditto	5.25	1.4	9.6	11.0
7	2	Precipitated carbonate of copper solution	2.58	.7	2.7	3.4
8	3	ditto	3.83	1.0	4.1	5.2
9	7	ditto	6.83	1.9	9.6	11.5
10	2	Copper saccharate	2.33	.9	2.7	3.7
11	3	ditto	3.20	1.3	4.1	5.4
12	7	ditto	6.20	2.5	9.6	12.2
13	2	Glue mixture	2.66	.9	2.7	3.7
14	3	ditto	4.28	1.5	4.1	5.7
15	7	ditto	7.28	2.6	9.6	12.3
16	2	Bordeaux mixture	2.33	.6	2.7	3.4
17	3	ditto	3.58	1.0	4.1	5.1
18	7	ditto	6.58	1.8	9.6	11.5
19	2	Copper acetate	2.66	.1	2.7	2.9
20	3	ditto	3.66	.2	4.1	4.3
21	7	ditto	7.66	.4	9.6	10.1
22	2	Copper chloride mixture	2.66	.6	2.7	3.4
23	3	ditto	3.91	.9	4.1	5.1
24	7	ditto	6.91	1.7	9.6	11.3
25	2	Potassium sulphide solution	2.58	.2	2.7	2.9
26	3	ditto	3.83	.3	4.1	4.4
27	7	ditto	5.83	.5	9.6	10.1
28	2	Sodium hyposulphite solution	2.66	----------	2.7	2.8
29	3	ditto	3.66	.1	4.1	4.2
30	7	ditto	7.66	.1	9.6	9.8

SUMMARY.

The results of the work, as set forth in the foregoing tables and remarks, may be summarized as follows:

(1) As preventives of both *Entomosporium* and scab on the fruit, the copper compounds gave decidedly better results than those in which no copper was used.

(2) Of the eight fungicides containing copper compounds, the ammoniacal carbonate of copper solution and modified eau celeste gave the best results in the prevention of leaf-blight, cracking, and scab, when all the treatments are considered.

(3) In all cases the seven treatments were more beneficial than the smaller number of two or three, although the difference in most cases was not sufficient to warrant the four additional sprayings. It is noticeable, however, that on the trees treated three times both scab and

Entomosporium were more abundant than when treated twice. This is especially observable with the glue mixture on *Entomosporium*, so much so, in fact, as to induce the belief that something must have occurred to vitiate the experiment; but it is also the case to a much less extent with the Bordeaux and copper chloride mixtures. Of all the copper compounds the copper saccharate and the glue mixture gave the best results for scab, with Bordeaux mixture as a close second; while for *Entomosporium* the ammoniacal solution gave the best results, followed by Bordeaux mixture. From this it is evident that the two diseases can not be successfully treated together by anything except Bordeaux mixture.

(4) There is no great difference in the cost of the treatments, the variation in the trees treated twice being from 2.8 cents to 4.7 cents, the former for sodium hyposulphite and the latter for ammoniacal solution. Proportionately, two treatments cost more than three, and three treatments more than seven, but less than two.

(5) Of the two compounds in which there was no copper at all, potassium sulphide gave the better results—better even than any of the copper compounds, as far as injury to foliage and fruit were concerned; but neither was so effective in preventing scab and *Entomosporium* as Bordeaux mixture. Sodium hyposulphite has comparatively little effect on *Entomosporium*, potassium sulphide giving far better results.

TREATMENT OF DISEASES OF NURSERY STOCK.

In 1889 a series of experiments resulting in the first successful method of protecting nursery stock from the attacks of a number of fungous diseases was inaugurated. This work was continued in 1890 with highly satisfactory results. The plan of the work in both these years necessitated the use of stock which had already been subjected to one, two, and even three seasons' attacks of parasitic fungi. While this was not objectionable in an experiment where the control stock was not treated at all, it did not afford a fair test of what could be done by beginning the work with the seedling or cutting, and continuing it uninterruptedly until the tree was of salable size. The experiments of 1889 and 1890 had shown that by preventing leaf-blight a growth could be obtained in two years equal to that of three where this disease was allowed to take its course. It was believed that by beginning the treatments with the seedling or cutting even more marked results could be obtained. With this idea in view the work in 1891 had for its object the following:

(1) To determine the feasibility of successfully growing French and American pear seedlings in this country. Pear seedlings are now nearly all imported from Europe, simply because they can not, except in a few favored localities, be grown here on account of leaf-blight.

(2) To determine the effect of spraying on growth, starting with the seedling or cutting, and continuing the work until the tree is of salable size.

(3) To determine the relative value, as far as resistance to disease is concerned, of different stocks; as for example Japan *versus* French pear seedlings; Mariana plum *versus* Myrobolan, etc.

The experiments designed to throw light on Question 1 were carried on at Geneva, N. Y. Work bearing on the other questions was conducted at both Geneva, N. Y., and Mullikin, Md.

The fungicides used were Bordeaux mixture, containing 6 pounds of copper sulphate and 4 pounds of lime to 22 gallons of water; ammoniacal solution of copper carbonate, consisting of 3 ounces of copper carbonate dissolved in 1 quart of ammonia (26°) strength, and diluted with 30 gallons of water; potassium sulphide solution, made by dissolving one-half an ounce of potassium sulphide in 5 gallons of water.

While the experiments at Geneva and Mullikin were in a measure identical, it is desirable to make a separate report on each. The treatments, therefore, may be properly divided into two parts:

(1) Experiments at Mullikin, Md.

(2) Experiments at Geneva, N. Y.

EXPERIMENTS AT MULLIKIN, MD.

Through the kindness of Franklin Davis & Co., of Baltimore, the facilities of their large nursery, located at Mullikin, Prince George County, Md., was placed at our disposal. The following is a list of the stock which was unpacked, planted, carefully cultivated, and budded under the direction of Mr. J. R. Jennings, the foreman of the nursery:

Pear seedlings, Japan	1,000
Pear seedlings, French	2,000
Cherry stocks, Mahaleb	500
Quince stocks	250
Apple seedlings	2,000
Plum stocks, Mariana	500

The piece of ground selected for the stocks was a moderately rich sandy loam, 700 feet long by 21 feet wide. It had been used for growing nursery stock since 1884 or '85, and was as uniform in fertility as could be obtained. For convenience the experimental plat was divided into 33 blocks, each of which was treated as set forth in the table below:

TABLE 19.—*Showing number and kinds of stocks in each block with method and date of treatment.*

Block.	No.	Kind of stocks.	Method of treatment.	Date of treatment.
1	404	Japan pear seedlings	Untreated.	
2	125	do	Bordeaux mixture	May 5, 19, June 1, 16, July 3.
3	125	do	do	May 5, 19, June 1, 16, July 3, 21, Aug. 10.
4	125	do	Ammoniacal solution.	May 5, 19, June 1, 16, July 3.
5	125	do	do	May 5, 19, June 1, 16, July 3, 21, Aug. 10.
6	100	do	Bordeaux mixture	May 19, June 1, 16, July 3, 21, Aug. 10.
7	784	French pear seedlings	Untreated.	
8	250	do	Bordeaux mixture	May 5, 19, June 1, 16, July 3.
9	250	do	do	May 5, 19, June 1, 16, July 3, 21, Aug. 10.
10	250	do	Ammoniacal solution.	May 5, 19, June 1, 16, July 3.
11	250	do	do	May 5, 19, June 1, 16, July 3, 21, Aug. 10.
12	100	do	Bordeaux mixture	May 19, June 1, 16, July 3, 21, Aug. 10.
13	200	Cherry stocks	Untreated.	
14	75	do	Bordeaux mixture	May 5, 19, June 1, 16, July 3.
15	75	do	do	May 5, 19, June 1, 16, July 3, 21, Aug. 10.
16	75	do	Ammoniacal solution.	May 5, 19, June 1, 16, July 3.
17	75	do	do	May 5, 19, June 1, 16, July 3, 21, Aug. 10.
18	50	Quince stocks	Untreated.	
19	59	do	Bordeaux mixture	May 5, 19, June 1, 16, July 3.
20	50	do	do	May 5, 19, June 1, 16, July 3, 21, Aug. 10.
21	51	do	Ammoniacal solution.	May 5, 19, June 1, 16, July 3.
22	50	do	do	May 5, 19, June 1, 16, July 3, 21, Aug. 10.
23	600	Apple seedlings	Untreated.	
24	225	do	Bordeaux mixture	May 5, 19, June 1, 16, July 3.
25	225	do	do	May 5, 19, June 1, 16, July 3, 21, Aug. 10.
26	225	do	Ammoniacal solution.	May 5, 19, June 1, 16, July 3.
27	225	do	do	May 5, 19, June 1, 16, July 3, 21, Aug. 10.
28	150	do	Potassium sulphide	May 19, June 1, 16, July 3, 21, Aug. 10.
29	298	do	do	May 5, 19, June 1, 16, July 3, 21, Aug. 10.
30	75	Plum stocks	Bordeaux mixture	May 5, 19, June 1, 16, July 3.
31	72	do	do	May 5, 19, June 1, 16, July 3, 21, Aug. 10.
32	75	do	Ammoniacal solution.	May 5, 19, June 1, 16, July 3.
33	78	do	do	May 5, 19, June 1, 16, July 3, 21, Aug. 20.
34	197	do	Untreated.	

The blocks were selected in such a way as to overcome any lack of uniformity in the character of the soil. For example, part of Block 1 was situated at the northwest or highest corner of the plat, while part was at the southwest corner, nearly 600 feet distant, where the ground was low and inclined to be moist.

It will be seen from the foregoing table that part of the stocks received seven treatments, part received six, and the rest received five. Those receiving six sprayings were treated first May 19, when the other blocks were being sprayed the second time. The reasons for adopting this plan may be briefly stated as follows:

(1) To ascertain the effects of early treatments.

(2) To determine the effects of treatments up to the time of budding as compared with those continued for a month or longer after the buds had been inserted.

Before proceeding with the results in detail it may be well to call attention to the preliminary nature of this report. The work of course, in so far as it relates to the first season, is complete. But it is possible that as the treatments continue the results may be somewhat modified. Keeping this point in mind, the work will now be taken up.

First treatment (May 5).—At this time the stocks were all in good condition, having been planted about three weeks before. The leaves on the pears, cherries, apples, and plums were just beginning to un-

fold. No disease of any kind had made its appearance, indicating that the work had commenced in advance of fungous attacks.

Second treatment (May 19).—A good rain fell on the 16th of May, and in consequence the ground was in excellent condition. The leaves on the various blocks made very little growth from May 5 to the 19th, the average size on the latter date being as follows:

	Inches.
Japan pear seedlings	.77 by 1.40
French pear seedlings	.50 by 1.20
Mahaleb cherries	.55 by .79
Quince stocks	1.00 by 1.50
Apple seedlings	.83 by 1.25
Mariana plum stocks	.66 by 1.27

Up to this time no disease whatever had appeared on either the treated or untreated blocks.

Third treatment (June 1).—The leaves on all of the blocks were about full grown when this treatment was made. No leaf-blight or other fungous disease had as yet made its appearance. In order to obtain some information as to the effect of the treatment on growth, ten stocks from each block were selected at random and measured. In the following table the results of these measurements are set forth:

TABLE 20.—*Showing the average height of the original stocks, length of new growth, and size of leaves in each block on June 1.*

Treatment.	Stocks.	Average height of original stock.	Average length of new growth.	Average size of leaves.
		Inches.	*Inches.*	*Inches.*
Untreated	Japan pear seedlings	5.51	2.50	1.00 by 1.68
Do	French pear seedlings	5.09	1.45	.79 by 1.13
Do	Mahaleb cherry stocks	8.18	2.73	.70 by 1.03
Do	Quince stocks	8.31	1.60	.83 by 1.08
Do	Apple seedlings	6.01	3.35	.81 by 1.96
Do	Mariana plum stocks	13.74	3.13	.65 by .90
Bordeaux mixture	Japan pear seedlings	5.40	2.55	.95 by 1.75
Do	French pear seedlings	5.09	1.60	.80 by 1.13
Do	Mahaleb cherry stocks	8.18	2.95	.69 by 1.10
Do	Quince stocks	8.31	2.05	.93 by 1.30
Do	Apple seedlings	6.01	3.70	1.05 by 1.90
Do	Mariana plum stocks	13.74	3.61	.60 by .91
Ammoniacal solution	Japan pear seedlings	5.50	2.71	.95 by 1.55
Do	French pear seedlings	5.09	1.41	.85 by 1.20
Do	Mahaleb cherry stocks	8.18	2.66	.70 by 1.06
Do	Quince stocks	8.31	2.39	1.05 by 1.35
Do	Apple seedlings	6.01	3.36	1.05 by 1.94
Do	Mariana plum stocks	13.74	2.74	.63 by .96
Potassium sulphide	Apple seedlings	6.01	2.98	.89 by 1.80

The nature of the experiment made it highly important to get stock as uniform in size as possible. The measurements in the foregoing table show that there was practically no difference in this respect.

Fourth treatment (June 16).—In carefully examining the stocks at this date it was found that the Bordeaux mixture had injured the foliage of the cherries and plums. Ammoniacal solution had also scorched the leaves on these trees, so that altogether the treated stock was not in as good condition as the untreated. Leaf-blight had appeared on

the Japan seedlings but this was the only place where disease of any kind was observed. An examination of the stocks revealed the fact that thirty-six of the untreated ones were affected with leaf-blight; three sprayed with Bordeaux mixture showed the disease and seven treated with the ammoniacal solution had their leaves slightly spotted. Ten stocks from each block were again measured, the results being as set forth in Table 21:

TABLE 21.—*Showing average height of original stocks, length of new growth, and average number of new shoots in each block on June 16.*

Treatment.	Stocks.	Average height of original stocks.	Average length of new growth.	Average number of shoots.
		Inches.	*Inches.*	*Inches.*
Untreated	Japan pear seedlings	5.51	5.21	2.4
Do	French pear seedlings	5.09	4.91	2.2
Do	Mahaleb cherry stocks	8.18	3.81	3.6
Do	Quince stocks	8.31	4.51	3.5
Do	Apple seedlings	6.01	4.83	2.3
Do	Mariana plum stocks	13.74	4.13	10.2
Bordeaux mixture	Japan pear seedlings	5.51	5.68	2.5
Do	French pear seedlings	5.09	4.64	2.2
Do	Mahaleb cherry stocks	8.18	4.64	3.9
Do	Quince stocks	8.31	4.02	3.5
Do	Apple seedlings	6.01	6.30	2.3
Do	Mariana plum stocks	13.74	4.13	9.7
Ammoniacal solution	Japan pear seedlings	5.51	6.63	2.7
Do	French pear seedlings	5.09	4.13	2.3
Do	Mahaleb cherry stocks	8.18	4.65	4.0
Do	Quince stocks	8.31	5.45	4.0
Do	Apple seedlings	6.01	5.13	2.3
Do	Mariana plum stocks	13.74	3.98	10.0
Potassium sulphide	Apple seedlings	6.01	5.52	1.9

Fifth treatment (July 3).—The only change worthy of note which took place between the time of the fourth and fifth treatments was the marked increase of leaf-blight on many of the blocks. The French pear seedlings were considerably affected, the disease being worse on the untreated. No leaf-blight had appeared on the quince, cherry, and plum stocks. The apples, however, were showing powdery mildew.

The time having arrived for budding the stock, the work was begun on July 17th and finished on the 18th. Each block was budded with three varieties in order to obtain a test of the treatments on susceptible, moderately susceptible, and resistant trees. In the following table is given a detailed account of the budding:

TABLE 22.—*Showing varieties budded and the number of each.*

Block.	No.	Kinds of stock.	Treatment.	Number and variety budded.	Number not budded on account of leaf-blight.	Total number dead.
1	404	Japan pear seedlings.	Untreated	110 Tyson	18	25
				121 Lawrence	9	
				106 Keiffer	15	
2	125	....do	Bordeaux mixture, 5 times.	37 Tyson	4	2
				38 Lawrence	4	
				40 Keiffer		
3	125	....do	Bordeaux mixture, 7 times.	39 Tyson	3	9
				35 Lawrence	4	
				30 Keiffer	5	
4	125	....do	Ammoniacal solution, 5 times.	40 Tyson	2	4
				39 Lawrence	2	
				35 Keiffer	3	
5	125	....do	Ammoniacal solution, 7 times.	39 Tyson	3	5
				40 Lawrence	2	
				33 Keiffer	3	
6	100	....do	Bordeaux mixture, 6 times.	31 Tyson		10
				28 Lawrence	2	
				29 Keiffer		
7	784	French pear seedlings.	Untreated	239 Tyson	15	30
				238 Lawrence	22	
				229 Keiffer	11	
8	250	....do	Bordeaux mixture, 5 times.	76 Tyson	6	4
				73 Lawrence	10	
				73 Keiffer	8	
9	250	....do	Bordeaux mixture, 7 times.	80 Tyson	1	4
				77 Lawrence	3	
				83 Keiffer	2	
10	250	....do	Ammoniacal solution, 5 times.	75 Tyson	7	7
				73 Lawrence	9	
				76 Keiffer	3	
11	250	....do	Ammoniacal solution, 7 times.	70 Tyson	12	11
				75 Lawrence	5	
				73 Keiffer	4	
12	100	....do	Bordeaux mixture, 6 times.	32 Tyson	1	2
				29 Lawrence	4	
				31 Keiffer	1	
13	200	Cherry stocks.	Untreated	40 Early purple		19
				43 Gov. Wood (50)	3	
				40 Black Tartar	5	
14	75	....do	Bordeaux mixture, 5 times.	20 Early purple	2	10
				11 Gov. Wood	8	
				22 Black Tartarian	2	
15	75	....do	Bordeaux mixture, 7 times.	21 Early purple		10
				20 Gov. Wood	2	
				17 Black Tartarian	5	
16	75	....do	Ammoniacal solution, 5 times.	20 Early Purple	2	14
				19 Gov. Wood	2	
				15 Black Tartarian	3	
17	75	....do	Ammoniacal solution, 7 times.	23 Early Purple	0	9
				20 Gov. Wood	4	
				16 Black Tartarian	3	
18	50	Quince stocks.	Untreated	14 Tyson	0	7
				13 Lawrence	1	
				12 Keiffer	3	
19	59	....do	Bordeaux mixture, 5 times.	19 Tyson	1	2
				13 Lawrence	7	
				17 Keiffer	0	
20	50	....do	Bordeaux mixture, 7 times.	13 Tyson	1	6
				11 Lawrence	1	
				16 Keiffer	2	
21	51	....do	Ammoniacal solution, 5 times.	13 Tyson	0	6
				14 Lawrence	0	
				18 Keiffer	0	
22	50	....do	Ammoniacal solution, 7 times.	12 Tyson	2	8
				13 Lawrence	0	
				14 Keiffer	1	
23	600	Apple seedlings.	Untreated	131 Rome Beauty	7	18
				130 C. R. June (154)	15	
				134 Ben Davis	11	
24	225	....do	Bordeaux mixture, 5 times.	65 Rome Beauty	8	5
				74 C. R. June	9	
				59 Ben Davis	5	
25	225	....do	Bordeaux mixture, 7 times.	61 Rome Beauty	12	18
				70 C. R. June	7	
				52 Ben Davis	5	

TABLE 22.—*Showing varieties budded and the number of each*—Continued.

Block.	No.	Kinds of stock.	Treatment.	Number and variety budded.	Number not budded on account of leaf-blight.	Total number dead.
26	225	Apple seedlings.	Ammoniacal solution, 5 times.	75 Rome Beauty 72 C. R. June 50 Ben Davis	5 8 6	9
27	225	....do	Ammoniacal solution, 7 times.	71 Rome Beauty 75 C. R. June 55 Ben Davis	7 4 2	10
28	150	....do	Ammoniacal solution, 6 times.	48 Rome Beauty 48 C. R. June 48 Ben Davis	1 3 1	4
29	298	....do	Potassium sulphide	92 Rome Beauty 87 C. R. June 86 Ben Davis	3 9 11	10
30	75	Plum stocks	Bordeaux mixture, 5 times.	26 German Prune 20 Shipper's Pride 15 Lombard	3 2 2	7
31	75	....do	Bordeaux mixture, 7 times.	19 German Prune 16 Shipper's Pride 18 Lombard	2 9 4	16
32	75	....do	Ammoniacal solution, 5 times.	22 German Prune 23 Shipper's Pride 22 Lombard	1 0 0	7
33	78	....do	Ammoniacal solution, 7 times.	24 German Prune 26 Shipper's Pride 23 Lombard	1 2 0	4
34	197	....do	Untreated	48 German Prune 40 Shipper's Pride 47 Lombard	2 50 8 0	2

The season had been a remarkably favorable one for the stock, and a correspondingly unfavorable one for the development of leaf-blight and other diseases. At the time of budding, therefore, the stock was in much better condition than it had been for a number of years, consequently the results set forth in the following pages are not so striking as they would have been under ordinary conditions. Up to this time the main object of the treatments had been to keep the stock in such condition that it could be budded with ease. Stocks even moderately affected with leaf-blight and other diseases of the foliage often work with great difficulty, the bark frequently refusing to slip and the buds, even if inserted, dying outright, or as nurserymen express it, refusing to "take."

To obtain the desired information as to the condition of the stocks with respect to the points just mentioned it was decided to make four grades of the trees, referring each to the proper grade when the bud was inserted. The grades were as follows:

(1) Stock that worked or budded with ease.
(2) Stock that worked with difficulty.
(3) Stock that refused to work.
(4) Dead stock.

Blanks for quickly tabulating these facts were prepared and as each budder called out the grade, this was marked in the proper column. The results of this work are set forth in the following table:

TABLE 23.—*Showing total number of stocks budded, condition of the stocks, number and variety used, etc.*

Block.	No.	Kind of stock.	Treatment.	Number and variety budded.	Worked with ease.	Worked with difficulty.	Refused to work.	Total No. dead.
1	404	Japan pear seedlings.	Untreated	128 Tyson	104	6	18	
				130 Lawrence	109	12	9	25
				121 Keiffer	96	10	15	
2	125	....do	Bordeaux mixture, 5 times.	41 Tyson	35	2	4	
				42 Lawrence	33	5	4	2
				40 Keiffer	36	4	.....	
3	125	....do	Bordeaux mixture, 7 times.	42 Tyson	34	5	3	
				39 Lawrence	32	3	4	9
				35 Keiffer	26	4	5	
4	125	....do	Ammoniacal solution, 5 times.	42 Tyson	37	3	2	
				41 Lawrence	34	5	2	4
				38 Keiffer	29	6	3	
5	125	....do	Ammoniacal solution, 7 times.	42 Tyson	38	1	3	
				42 Lawrence	37	3	2	5
				36 Keiffer	30	3	3	
6	100	....do	Bordeaux mixture, 6 times.	31 Tyson	31	.....	.....	
				30 Lawrence	21	7	2	10
				29 Keiffer	26	3	.....	
7	784	French pear seedlings.	Untreated	261 Tyson	220	19	15	
				260 Lawrence	209	29	22	23
				240 Keiffer	117	12	11	
8	250	....do	Bordeaux mixture, 5 times.	82 Tyson	67	9	6	
				83 Lawrence	66	7	10	4
				81 Keiffer	64	9	8	
9	250	....do	Bordeaux mixture, 7 times.	81 Tyson	79	1	1	
				80 Lawrence	73	4	3	4
				85 Keiffer	78	5	2	
10	250	....do	Ammoniacal solution, 5 times.	82 Tyson	68	7	7	
				82 Lawrence	66	7	9	7
				79 Keiffer	71	5	3	
11	250	....do	Ammoniacal solution, 7 times.	82 Tyson	66	4	12	
				80 Lawrence	72	3	5	11
				77 Keiffer	69	4	4	
12	100	....do	Bordeaux mixture, 6 times.	32 Tyson	32	.....	1	
				29 Lawrence	27	2	4	2
				31 Keiffer	31	.....	1	
13	200	Cherry stocks.	Untreated	40 Early Purple	34	6	.....	
				43 Gov. Wood	41	2	3	50 19
				40 Black Tartarian.	34	6	5	
14	75	....do	Bordeaux mixture, 5 times.	20 Early Purple	20	.....	2	
				11 Gov. Wood	11	.....	8	9
				22 Black Tartarian.	19	3	2	
15	75	....do	Bordeaux mixture, 7 times.	21 Early Purple	21	.....	.....	
				20 Gov. Wood	17	3	2	10
				17 Black Tartarian.	15	2	5	
16	75	....do	Ammoniacal solution, 5 times.	20 Early Purple	15	5	2	14
				19 Gov. Wood	16	3	2	
				15 Black Tartarian.	11	4	3	
17	75	....do	Ammoniacal solution, 7 times.	23 Early Purple	20	3	0	
				20 Gov. Wood	16	4	4	9
				16 Black Tartarian.	14	2	3	
18	50	Quince stocks.	Untreated	14 Tyson	11	3	0	
				13 Lawrence	11	2	1	9
				12 Keiffer	10	2	3	
19	59	....do	Bordeaux mixture, 5 times.	19 Tyson	18	1	1	
				13 Lawrence	10	3	7	2
				17 Keiffer	11	6	0	
20	50	....do	Bordeaux mixture, 7 times.	13 Tyson	10	3	1	
				11 Lawrence	8	3	1	6
				16 Keiffer	14	2	2	
21	51	....do	Ammoniacal solution, 5 times.	13 Tyson	13	0	0	
				14 Lawrence	13	1	0	6
				18 Keiffer	15	3	0	
22	50	....do	Ammoniacal solution, 7 times.	12 Tyson	8	4	2	
				13 Lawrence	11	2	0	8
				14 Keiffer	12	2	1	
23	600	Apple seedlings.	Untreated	131 Rome Beauty	129	2	7	
				130 C. R. June	123	7	15	18
				134 Ben Davis	126	8	11	

TABLE 23.—*Showing total number of stocks budded, etc.*—Continued.

Block.	No.	Kind of stock.	Treatment.	Number and variety budded.	Worked with ease.	Worked with difficulty.	Refused to work.	Total No. dead.
24	225	Apple seedlings.	Bordeaux mixture, 5 times.	65 Rome Beauty	60	5	8	
				74 C. R. June	65	9	9	5
				59 Ben Davis	59	0	5	
25	225	....do	Bordeaux mixture, 7 times.	61 Rome Beauty	55	6	12	
				70 C. R. June	64	6	7	24
				52 Ben Davis	50	2	5	
26	225	....do	Ammoniacal solution, 5 times.	75 Rome Beauty	73	2	5	
				72 C. R. June	66	6	8	9
				50 Ben Davis	46	4	6	
27	225	....do	Ammoniacal solution, 7 times.	71 Rome Beauty	65	6	7	
				75 C. R. June	72	3	4	10
				55 Ben Davis	53	2	2	
28	150	....do	Ammoniacal solution, 6 times.	48 Rome Beauty	45	3	1	
				48 C. R. June	45	3	3	4
				48 Ben Davis	47	1	1	
29	298	....do	Potassium sulphide	92 Rome Beauty	85	7	3	
				87 C. R. June	81	6	9	10
				86 Ben Davis	84	2	11	
30	75	Plum stocks	Bordeaux mixture, 5 times.	26 German Prune	20	6	3	
				20 Shipper's Pride	17	3	2	0
				15 Lombard	13	2	2	
31	75	....do	Bordeaux mixture, 7 times.	19 German Prune	12	7	2	
				16 Shipper's Pride	12	4	9	16
				18 Lombard	14	4	4	
32	75	....do	Ammoniacal solution, 5 times.	22 German Prune	15	7	1	
				23 Shipper's Pride	20	3	0	7
				22 Lombard	20	2	0	
33	78	....do	Ammoniacal solution, 7 times.	24 German prune	16	8	1	
				26 Shipper's pride	25	1	2	4
				23 Lombard	21	2	0	
34	197	....do	Untreated	48 German Prune	43	5	2	
				40 Shipper's Pride	36	4	8	2
				47 Lombard	45	2	0	

Sixth treatment (July 21).—It will be seen by consulting Table 19 that blocks 3, 5, 6, 9, 11, 12, 15, 17, 20, 22, 25, 27, 29, 31, 33, were treated at this time. In the case of the Japan pear seedlings there was a marked difference between the treated and the untreated blocks. In many cases the latter had lost nearly all of their leaves from leaf-blight, while only a few of the trees here and there on the treated blocks were showing signs of the disease. The French stocks did not show the difference as markedly as the Japan, although the leaves on many of these trees had been removed by the disease. Very little leaf-blight occurred on the cherries, quinces, and plums; in fact, there was not enough to make a comparison. The apples were also in fair condition, little or no powdery mildew having appeared on them.

Seventh treatment (August 10).—The condition of the various blocks may perhaps be best described by quoting from field notes made immediately after the treatments.

Japan pear seedlings.—Nearly every untreated tree is defoliated and the leaves still attached are all badly diseased. The stocks treated with Bordeaux mixture five times are growing nicely, having lost very little of their foliage. Bordeaux mixture seven treatments is better than the last and is also better than six sprayings. None of the blocks treated with ammoniacal solution of copper carbonate are in as good condition as those sprayed with the Bordeaux mixture, although they are infinitely better than those not treated at all.

French pear seedlings.—The untreated stocks have lost from one-fourth to one-half of their leaves, and those remaining are badly spotted with the leaf-blight fungus. Stocks treated five times with Bordeaux mixture show considerable leaf-blight, but very few of the leaves have fallen. Seven treatments with ammoniacal solution are better than five or six, but not so good as any of the blocks sprayed with Bordeaux mixture.

Cherry stocks.—There is considerable leaf-blight on the untreated trees, many of the leaves being spotted and some are now falling. Trees treated five times with Bordeaux mixture show some few spots, but so far as can be seen none of the leaves have fallen. Seven treatments with Bordeaux mixture has kept the trees in perfect condition, not a trace of leaf-blight being found. There is no difference between the blocks sprayed six times and those receiving seven treatments; furthermore, there is no appreciable difference between the blocks sprayed with Bordeaux mixture and those treated with ammoniacal solution.

Quince stocks.—There is no difference between the untreated and treated blocks, no leaf-blight of consequence having appeared.

Apple seedlings.—What is said of the quince stocks is applicable here. Usually the powdery mildew is abundant at this season of the year, but now scarcely a trace of it can be found.

Plum stocks.—In every case the untreated look better than the treated. There is some leaf-blight on the untreated leaves, but the injury to the treated is much greater than any damage through this source.

On August 24 it was decided to make a final examination of all pear stock in order to obtain some data as to the actual condition of each block. Each tree was examined and according to condition was referred to one of the following grades:

First quality: Having all the leaves perfect, *i. e.*, showing no leaf-blight whatever.

Second quality: Having spotted leaves here and there, but none lost through the attacks of the disease.

Third quality: All leaves more or less spotted and some removed by leaf-blight.

Fourth quality: Trees entirely defoliated by leaf-blight.

The results of this count are set forth in Table 24 and illustrated graphically in Plate IV.

TABLE 24. *Showing the condition of the pear stocks August 24 with respect to leaf-blight.*

Block.	No. and kind of stock.	Treatment.	No. 1 quality.	No. 2 quality.	No. 3 quality.	No. 4 quality.	Dead.
1	404 Japan pear seedlings..	Untreated	.....	87	116	169	32
2	125 Japan pear seedlings..	Bordeaux mixture, five treatments	1	62	37	17	8
3	125 Japan pear seedlings..	Bordeaux mixture, seven treatments	30	61	21	8	5
4	125 Japan pear seedlings..	Ammoniacal solution, five treatments	.....	40	48	29	8
5	125 Japan pear seedlings..	Ammoniacal solution, seven treatments	15	55	29	20	6
6	100 Japan pear seedlings..	Bordeaux mixture, six treatments	30	51	25	5	9
7	784 French pear seedlings..	Untreated	.....	12	132	609	26
8	250 French pear seedlings..	Bordeaux mixture, five treatments	.....	44	153	43	10
9	250 French pear seedlings..	Bordeaux mixture, seven treatments	39	85	28	9	89
10	250 French pear seedlings..	Ammoniacal solution, five treatments	1	17	76	143	7
11	250 French pear seedlings..	Ammoniacal solution, seven treatments	9	100	96	34	10
12	100 French pear seedlings..	Bordeaux mixture, six treatments	30	39	31	.....	.....

In Plate IV each tree is represented by a line, the length of the latter indicating the grade.

EXPERIMENTS AT GENEVA, N. Y.

The experiments at this place were undertaken at the earnest solicitation of a large number of nurserymen who became interested in the work from the published reports of the Department. Early in the spring a consultation was held with the nurserymen and a plan of action agreed upon. Dr. Peter Collier, of the State Experiment Station at Geneva, took great interest in the work, calling the nurserymen together, furnishing the necessary ground on the station farm for conducting the experiments, and in other ways materially aiding the investigations. As stated in the introduction, this work was placed in charge of Mr. D. G. Fairchild, who spent the summer at Geneva in order that the experiments might at all times be subject to personal inspection. The following account of the work at Geneva has been prepared by Mr. Fairchild:

REPORT OF MR. D. G. FAIRCHILD.

The interest taken in the experiment at Geneva by the nurserymen, at whose request the Department undertook the work, is shown by the generous donations of stock. The following is a list of the stock donated, together with the names of the donors:

Number.	Stocks.	Donors.
500	Cherry, Mahaleb	Hammond & Willard, Geneva.
500	Cherry, Mazzard	Selover & Atwood, Geneva.
500	Plum, Myrabolan	R. G. Chase & Co., Geneva.
250	Plum, Mariana	Sears, Henry & Co., Geneva.
250	Plum, Mariana	W. & T. Smith, Geneva.
500	Quince, Angers	H. S. Anderson, Lockport.
500	Pear stocks, French	R. G. Chase & Co., Geneva.
500	do	E. Moody & Sons, Lockport.
500	do	Selover & Atwood, Geneva.
500	do	Thos. McKay, Geneva.
500	Pear stocks, Japan	Franklin Davis & Co., Baltimore.
2,000	Pear stocks, American	Smiths & Powell, Geneva.
1,000	Apple stocks, American	Sears, Henry & Co., Geneva.
500	Apple stocks, French	R. G. Chase & Co., Geneva.
500	do	W. & T. Smith, Geneva.
500	Peach seedlings	Thos. McKay, Geneva.
*2,000	Seed for pear stocks	Sears, Henry & Co., Geneva.
*2,000	Seed for apple stocks	Hammond & Willard, Geneva.

*None of the seed germinated.

Mr. Howard Merrell and Selover and Atwood, to further show their interest in the matter, donated $5 each to pay freight charges.

All of the foregoing were planted upon the farm of the New York State Experiment Station. The soil selected for the work, although not entirely suited to the growth of apple and pear stock, was well adapted to the growing of plum and cherry. The ground was prepared in the usual way and the stock planted in the ordinary manner, except that perhaps unusual care was taken that every stock should be firmly packed into the soil. The planting was begun April 27 and finished May 3, with the exception of 500 French pear seedlings, which were not put out until May 10.

Each row of stock was divided for convenience into seven sections, six being treated and one untreated. Alternate sections of the six divisions were treated with Bordeaux mixture and ammoniacal solution, respectively. The sections were consecutively numbered, 1, 3, and 5 being treated with ammoniacal solution and 2, 4, and 6 with

Bordeaux mixture. One-half of each treated section received three treatments; the other half, six in case of apples, quinces, peaches, and plums, and seven in case of pears and cherries. The dates of treatment were May 21, June 3, June 24, July 9, July 24, August 8, and August 28.

In addition to the treatments with fungicides it was found necessary the first week in July to spray all apple and pear stocks for the apple aphis (*Aphis mali*), and also a large portion of the cherry stocks for the black cherry aphis (*Mysus cerasi*). Owing to the persistence of these pests the treatments were repeated three times at intervals of from three to eight days. Kerosene emulsion, prepared by the Hubbard-Riley formula as well as by the Cook formula, was used with moderate success. Whale-oil soap and tobacco water gave, however, as good results, though none of these were sufficient to entirely keep the insects in check, and in consequence serious injury to the apple seedlings resulted.

Immediately after planting a drought set in, and as a result the stocks started very slowly. As the season advanced, however, the effects of this early check passed away and a fair growth was made. A considerable difference in the growth of the stocks contributed by various firms was noticed, and owing to this difference it will be impossible to make any comparison between French and American pear or apple seedlings. In fact the comparison between foreign and domestic seedlings as stocks for standard varieties of fruit trees is altogether too complex a problem to be treated by this simple experiment. Any unmistakable evidence, however, of the superiority or inferiority of one kind or another will be recorded at the end of the next season.

The results of the treatments may probably be best shown by giving a record for each lot of stocks, repeating for the sake of clearness the manner of treatment and adding for future reference the date of budding and the varieties used in each case.

Rows I and II (Mahaleb and Mazzard cherry stock).—One row each of Mahaleb and Mazzard cherry stocks, containing 449 and 468 trees, respectively, was experimented upon. Each row was divided into seven sections, as described above, three treated with ammoniacal solutions and three with Bordeaux. Half of each section was treated three times and the other half six times. One-half of the treated Mazzard stock (Row II), however, received an additional treatment, making seven in all.

The leaf-blight (*Cylindrosporium padi* Karsten) was present only in insignificant quantities, defoliating but 15 Mahaleb seedlings and 17 Mazzards. The greatest defoliation was in the untreated portion.

The powdery mildew (*Podosphæra oxyacanthæ* (D. C.) Wint.) appeared the last of August upon the Mazzard stock to a slight extent, more pronounced upon the untreated and early treated than upon those portions sprayed seven times. (See Fig. 6, Plate v.) The benefit of the latter spraying was plainly evident in the prevention of the mildew.

Summarizing the result it may be said that the leaf-blight appeared too late in the season and in too small a quantity to furnish a test of the efficacy of the fungicides.

The powdery mildew on the Mazzard stocks was in a measure prevented by six treatments with Bordeaux mixture and in a less degree by six applications of the ammoniacal solution. Early treatments had no preventive effect. The stock was budded August 5 with Windsor, Yellow Spanish and Mont Morency.

Rows III and IV (Myrabolan and Mariana plum).—One row each of the Myrabolan and Mariana plum stock was planted and treated almost identically with the cherry stock, but on October 9 no disease had yet appeared and no difference was observed between the treated and untreated trees. No injury to the foliage from the applications was apparent. The plants were budded September 9 with Early Rivers, Hudson River Purple Egg, and Fellenberg.

Row V (Angers quince).—One row of 509 Angers quince stocks was planted and treated as described for the Mahaleb cherry. On October 9 the difference between the treated and untreated trees was not apparent, but the trees were tabulated as diseased when not absolutely without a single spotted leaf, with the following results represented in percentages.

	Absolutely perfect.
Treated with ammoniacal solution 3 times	64 per cent.
Treated with ammoniacal solution 6 times	54 do.
Treated with Bordeaux mixture 3 times	63 do.
Treated with Bordeaux mixture 6 times	73 do.
Untreated	82 do.

These results can not be considered at all decisive and only point to the necessity of the presence in quantity of the disease to be combated in order that a comparative test of fungicides may be of value. These stocks were budded August 6 with Duchess, Flemish Beauty, and Anjou.

Rows VI, VII, VIII, and XXI (French pear stock).—Three rows (VI, VII, and VIII), containing 1,454 stocks, were planted the 1st of May, and one row (XXI), containing 468 trees, was planted the 10th of May.* The treatments were identical with those described for Row II, the whole number of trees being divided into seven sections, six being treated, three with ammoniacal solution and three with Bordeaux mixture.

In Plate V (Figs. 1, 2, 3, and 4) is shown the actual condition of each seedling with respect to leaf-blight on the 23d of September, each line representing the grade in which the individual seedling was classed. Fig. 4, which occupies a low grade relatively, represents the condition of Row XXI, planted one week later. From the condition of treated and untreated stock it seems reasonably fair to draw the following conclusions:

(1) Seven treatments, at dates given above, with Bordeaux mixture proved efficacous in preventing the leaf-blight of French pear stock.

(2) Three treatments of Bordeaux mixture, made at early dates, proved ineffectual in the prevention of leaf-blight.

(3) Ammoniacal solution in no case proved as effectual as Bordeaux mixture.

(4) From all indications it seems evident that the treatments of this year's experiment were made three weeks earlier than necessary, taking into consideration the dryness of the spring. The trees were budded August 6 with Duchess, Flemish Beauty, and Anjou.

Row IX (Japan pear stock).—One row of 466 trees was treated the same as Row II with results almost identical with, but not perhaps so striking, as those obtained from Rows VI, VII, VIII, and XXI. The treatments with Bordeaux mixture proved thoroughly effectual in the prevention of leaf-blight, in one case giving a block absolutely free from the disease. The ammoniacal solution was much less effective than the Bordeaux mixture. (See Plate v, Fig. 5.) The trees were budded on August 5 with Duchess, Flemish Beauty, and Anjou.

Rows X, XI, XII, and XIII (American pear stock).—Four rows were planted and divided into seven sections, six of which were treated and one left untreated. The stock, as explained above, was in poor condition when planted and made but feeble growth. The record of the condition of the stock as regards leaf-blight is given below:

TABLE 25.—*Showing condition of American pear stock as regards leaf-blight.*

	Number of stocks alive.	Number of first quality.	Number of second quality.	Number of third quality.	Number of fourth quality.	Per cent wholly free from disease.
Untreated	421	1	16	50	353	.002
Bordeaux mixture, 7 treatments	326	128	70	34	94	.392
Bordeaux mixture, 3 treatments	288	.....	2	12	276	.....
Ammoniacal solution, 7 treatments	313	.....	.....	34	277	.....
Ammoniacal solution, 3 treatments	325	1	9	32	283	.003

* To this oversight in the planting is attributable in part the poor growth made by Row XXI during the season, but the inferiority of the stock over those of Rows VI, VII, and VIII aided undoubtedly in making the difference more noticeable.

The inference from the above table is plainly that only seven treatments of the Bordeaux mixture were of material value in preventing the disease. The trees were budded on August 7 with Duchess, Flemish Beauty, and Anjou.

Rows XIV, XV, XVI, XVII (American and French apple stock).—Of the four rows treated for the prevention of this disease, two were American and two French stock. The treatments were made as described for the other stock, but owing to the fact that scarcely any mildew made its appearance no evidence as to the efficacy of the fungicides could be obtained. The trees were budded on August 7 with Twenty Ounce, Fameuse, and Early Strawberry.

Peach seedlings.—Eighty-three of these lived and they were treated three times with Bordeaux mixture and ammoniacal solution without injurious effects. Owing to the nonappearance of leaf curl no results were obtained. The trees were budded on August 7 with Early Crawford.

Treatment of apple seedlings for powdery mildew.—One row of apple seeds was planted in the usual way the last of April, and covered with a slight mulching of muck. The row was divided, into five sections and treated with ammoniacal solution and Bordeaux mixture, as shown below. On October 9 every seedling was examined and classed as diseased if the slightest trace of mildew was present, and healthy if no disease was seen. While it was evident that no good effects were produced by the early sprayings as far as prevention of the mildew was concerned, nothing can be concluded from the experiment as to the efficiency or inefficiency of the mixtures themselves. The mixtures were without doubt washed off before the appearance of the disease. The treatments were made May 21, June 3, 24, July 9, 24, and August 8 where six applications were tested, and May 21, June 3 and 24 where three were tried. The disease appeared the first week in September. A tabulated result of the count is given below:

TABLE 26.—*Showing the results in the experiment for prevention of powdery mildew in apple seedlings.*

	No. of healthy.	No. of diseased.	Per cent diseased.
Ammoniacal solution, 3 treatments	165	159	49
Ammoniacal solution, 6 treatments	154	104	40.3
Bordeaux mixture, 3 treatments	73	168	69.7
Bordeaux mixture, 6 treatments	106	119	52.8
Untreated	64	84	56.7

AN EXPERIMENT IN THE TREATMENT OF PEACH ROT.

(*Monilia fructigena* Persoon.)

The rot of peaches is unquestionably one of the worst fungus diseases with which the growers of this fruit have to contend. It is especially prevalent on the early crop and for this reason is more than usually feared, as the profits on peaches at this time are as a rule greater than at any other season.

In the hope of obtaining information that would throw light on the treatment of this disease, a series of experiments was made in the orchard of Mr. James S. Harris, near Still Pond, Md. At the outset it may be as well to say that the results of the work were wholly negative, this being largely due to the small amount of rot which prevailed on both treated and untreated trees. In spite of this nonsuccess of

the work it seems desirable to put on record what was done in order to see where we stand in case further experiments are undertaken. For the work in hand a plat consisting of thirty-six Hale's Early trees was selected. The plat was divided into eighteen blocks of two trees each, seventeen of which were treated with the following fungicides, while one was left for control.

(1) Ammoniacal solution of copper carbonate made by adding one-half a pint of the concentrated solution* to 11 gallons of water.

(2) Bordeaux mixture, half strength, *i. e.*, 3 pounds of copper sulphate, 2 pounds of lime, to 22 gallons of water.

(3) Flowers of sulphur.

The work was planned in order to test the effect of the foregoing preparations on rot when applied as below described.

(*a*) Once when the trees were in full bloom.

(*b*) Twice; once when in full bloom, and again when the fruit was the size of peas.

(*c*) Four times; once when in full bloom, then 15, 10, and 5 days, respectively, before ripening.

(*d*) Five times; once when in full bloom, once when the fruit was the size of peas, then three times the same as in the last treatment.

(*e*) Three times; 15, 10, and 5 days, respectively, before the fruit ripened.

As a rule, rot is more prevalent while the fruit is ripening or during the so-called swelling period. By frequent application of fungicides at this time it was hoped that the disease might be overcome. As the work progressed four careful examinations were made of the peaches, the rotten and healthy ones being determined each time. There was no difference whatever, so far as rot was concerned, in favor of any of the treatments, the loss of fruit on each tree, with the exception of those sprayed with Bordeaux mixture, averaging from 2 to 5 per cent. The trees sprayed with Bordeaux mixture were badly injured by the first two treatments, the leaves being completely destroyed and every flower killed. No further applications were made to these trees, and toward the latter part of the season they had practically recovered. The damage resulting from the application of the Bordeaux mixture was probably due to the fact that air-slaked lime was used in making the preparation. Bordeaux mixture, however, even when made with the greatest care, often injures peach foliage severely.

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* This was prepared in the usual way by dissolving 3 ounces of copper carbonate in 3 pints of strong ammonia.

MISCELLANEOUS WORK IN NEW YORK STATE.

By D. G. Fairchild.

TREATMENT OF APPLE SCAB AT BROCKPORT.

Forty trees, the property of Mr. Udell, were chosen for this experiment. Twenty of the trees were of the Twenty-Ounce variety, and in bearing at the time of treatment, while the others (Baldwins) were not bearing. The following fungicides were employed to ascertain their relative effectiveness:

(*a*) *Ammoniacal solution of copper carbonate* (5 ounces copper carbonate dissolved in 3 pints of ammonia (26°), and diluted with 45 gallons of water).

(*b*) *Modified eau celeste* (1¼ pounds copper sulphate, 1¼ pounds sodium carbonate, 1 pint ammonia (26°), 52 gallons of water).

(*c*) *Bordeaux mixture* (1½ pounds copper sulphate, 1½ pounds fresh lime, 45 gallons of water).

(*d*) *Potassium sulphide* (5 ounces potassium sulphide in 48 gallons of water).

Three treatments were made by Mr. Udell. On May 4,* ten days before blooming, May 19, while in full bloom, and on June 8. An examination made July 11 showed an entire absence of *Fusicladium* from both treated and untreated trees. Thus the experiment, owing to the absence of the disease, was entirely negative.

TREATMENT OF PLUM LEAF-BLIGHT† IN THE ORCHARD.

Two experiments in quite widely separated orchards at Geneva, N. Y., were made in the treatment of leaf-blight. The trees were kindly put at the disposal of the Department by their owners, Mr. T. C. Maxwell and Mr. A. Hammond, who aided the experiment in every possible way. According to the statement of the owners, the leaf-blight had often defoliated the trees in July and August, and the experiments were planned with the view of preventing this destructive early fall of the leaves. It was also desired to test in a comparative way the effects of a few fungicides, either not heretofore employed or not employed in so dilute a form. Unfortunately for the experiment, leaf-blight appeared in the orchards unusually late, not causing serious leaf fall until the latter part of September. Thus this experiment was also negative, for the fungicides applied in May and June failed to prevent the appearance of the disease in September. It seems best, however, to place upon record the results obtained, and to also make a note as to the effects of the fungicides upon the foliage. The following fungicides were employed:

(*a*) *Ammoniacal solution* (0.1 ounce of copper carbonate dissolved in 0.1 ounce ammonia per gallon of water).

(*b*) *Potassium sulphide* (0.1 ounce per gallon of water).

*With the exception of potassium sulphide, which was not applied until the 12th.

†Disease caused by *Cylindrosporium padi* Karsten.

(*c*) *Copper acetate* (0.1 ounce per gallon of water).

(*d*) *Copper acetate* (0.2 ounce per gallon of water).

(*e*) *Bordeaux mixture** (0.1 ounce copper sulphate combined with ¾ ounce slaked lime per gallon of water).

(*f*) *Chloride of lime* (0.1 ounce per gallon of water).

(*g*) *Chloride of lime* (0.2 ounce per gallon of water).

(*h*) *Chloride of lime* (0.3 ounce per gallon of water).

The only one of these fungicides heretofore used of so weak a strength is the ammoniacal, this being the usual formula. The two varieties of plums treated were the "Middlebush" and "Copper." The former were sprayed May 28, June 12, and June 29; the latter May 6, May 21, and June 15. In none of the experiments could any very perceptible difference be noted between treated and untreated trees, except where chloride of lime was applied. This chemical caused the leaves to fall a trifle earlier than on untreated trees. A similar effect was produced upon quinces, as mentioned later on. No injurious effects were observed upon the foliage from treatments with any of the other chemicals.

TREATMENT OF PLUM LEAF-BLIGHT IN NURSERY ROWS.

In the neighborhood of Geneva the seedlings of the "horse-plum," a form of *Prunus domestica*, are used extensively for stocks. The various desirable varieties are budded on these seedlings at two and one-half years from seed, but it would be desirable if the budding could be done when they were one and one-half years old, *i. e.*, in the second season. The opinion has been expressed by several nurserymen that were it not for leaf-blight the horse-plum seedlings would make enough growth by the second season to be fit for budding.

At the time work was begun at Geneva no seedlings of the first year's growth were obtainable, but it was thought wise to carry on a preliminary experiment with seedlings of the second season's growth. The object of the experiment was to ascertain, if possible, whether the foliage could be kept intact by the application of the copper mixtures. As the leaves of the second season's growth are almost as badly attacked by the fungus as those of the first season, the success of the experiment would point encouragingly to the prevention of leaf-blight the first season.

The block chosen for the experiment was the property of Mr. O'Brian, and was situated in the city of Geneva. The fear of the owner that the seedlings would be injured interrupted the experiment before it was completed, and only one row instead of two was sprayed with Bordeaux mixture. Five rows finally constituted the experimental block, two for control and three for treatment, situated as shown in the table below. The nursery rows were 2 feet apart and the individual seedlings were planted irregularly. They varied from 400 to 1,200 in each row.

* One-tenth ounce of copper sulphate, when combined with lime, forms .038 ounce copper hydroxide.

The presence of the disease was observed the day previous to the first treatment, and had the weather which followed been ordinarily wet, the defoliation of the untreated plants would presumably have been much earlier. As the wet weather occurred late, the defoliation was not conspicuous much before the middle of August.

Row I.—Treated with Bordeaux mixture, reduced formula (2 pounds copper sulphate, 1 pound of lime, 20 gallons of water).

Row II.—Untreated.

Row III.—Untreated.

Row IV.—Treated with ammoniacal solution (2 ounces copper carbonate, 20 ounces ammonia (26°), 20 gallons of water).

Row V.—Treated same as IV.

The sprayings were made July 2, 14, and 25. To estimate the percentage of foliage upon the treated and untreated seedlings the leaves of every twentieth tree were carefully counted on September 17 and 18. At this time growth had quite generally ceased, and the results are thought to be of more value than if taken later, when the autumnal ripening of the leaves had begun and the potash, phosphoric acid, and starch had been withdrawn into the twigs.*

The average number of leaves found upon the seedlings may be taken as representing *inversely* the relative loss to the plants. Thus the proportion of foliage lost by the seedlings of Row I to that of Row II stands as 16:110.7. The condition of the numerous rows standing on either side of the experimental portion was fairly represented by the condition of the untreated rows and afforded fully as striking a comparison as that shown below.

Row I.—*Bordeaux mixture.*

Number of trees	430
Number of sample trees	21
Total number of leaves	2,325
Average number of leaves	110.7

Row II.—*Untreated.*

Number of trees	640
Number of sample trees	32
Total number of leaves	513
Average number of leaves	16.0

Row III.—*Untreated.*

Number of trees	593
Number of sample trees	29
Total number of leaves	437
Average number of leaves	15.0

*Fliche and Graudeau, Ann. Chem. et Phys., ser. 5, vol. viii, p. 486; quoted by R. Warington in Watt's Dict. Chem., ed. of 1883, Supple., vol. viii, pt. 1, pp. 813–816.

Row IV.—*Ammoniacal solution of copper carbonate.*

Number of trees	490
Number of sample trees	24
Total number of leaves	923
Average number of leaves	38.4

Row V.—*Ammoniacal solution of copper carbonate.*

Number of trees	1,200
Number of sample trees	60
Total number of leaves	1,708
Average number of leaves	28.04

TESTS OF FUNGICIDES FOR QUINCE SPOT.*

An experiment was made through the courtesy of T. C. Maxwell & Bros., in one of their large orchards, to test the efficacy of a few fungicides as preventives of quince spot. The orchard is situated a few miles from Geneva, on the east side of Seneca Lake, and is planted entirely with the apple or orange variety of quince. The method of culture is perfect, but for several years the fruit and foliage has been seriously affected by "spot." The block chosen for experiment was in that portion of the orchard which had suffered most severely the previous year, and consisted of three rows of thirty-four trees each. The trees of only the center row were treated, the rows on either side being left for control. Each experimental plat consisted of three trees, two of which were sprayed three times; first, just as the petals were falling, May 29, and twice afterward, June 15 and 29. The remaining tree was treated twice more, on July 16 and 30. Hence No. 1 of each plat received five treatments while Nos. 2 and 3 received only three. The solutions used were calculated to deposit upon drying on the leaf as nearly as possible .1 of an ounce of the salt from every gallon of the mixture. This quantity is as closely as possible that deposited by every gallon of the regular ammoniacal solution of copper carbonate, viz, 3 ounces copper carbonate dissolved in ammonia and diluted with 22 gallons of water. The following were the fungicides used. As seen below, *d*, *f*, and *g* were twice or thrice as strong as the above:

(*a*) *Bordeaux mixture* (7.5 grams copper sulphate,† 10 grams slaked lime, 2 gallons of water.

(*b*) *Copper acetate* (7.5 grams wet with 30cc water, and after standing from twelve hours to twenty-eight days diluted with 2 gallons of water).

(*c*) *Potassium sulphide* (7.5 grams dissolved in 1 ounce of water, and after standing from twelve hours to twenty-eight days diluted with 2 gallons of water).

(*d*) *Copper acetate* (15 grams wet with 60cc of water, and after standing from twelve hours to twenty-eight days diluted with 2 gallons of water).

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* *Entomosporium maculatum* Lév.

† Seven and one-half grams of copper sulphate, $CuSo+5H_2O$ give, upon precipitation as the dry hydrate, only 2.8 grams of $Cu(OH)_2$. Consequently the amount of salt thrown on the leaf is smaller than at first calculated, less than .05 of an ounce per gallon of water.

(*e*) *Chloride of lime* (7.5 grams wet with about 1 ounce of water and added at once to 2 gallons of water).

(*f*) *Chloride of lime* (15 grams wet with about 2 ounces of water and added at once to 2 gallons of water).

(*g*) *Chloride of lime* (22.5 grams wet with about 3 ounces of water and added at once to 2 gallons of water).

(*h*) *Glue mixture* (7.5 grams of copper sulphate, 8 grams * of sodium carbonate, and 5 grams of Le Page's glue mixed, and after standing from twelve hours to twenty-eight days added to 2 gallons of water).

The leaf-blight appeared toward the latter part of July to a slight extent, and was observed at that date on the sections sprayed with chloride of lime as well as upon the unsprayed rows. The spread of the disease was not, however, as extended nor as severe as ordinary, but the attack upon the fruit was sufficiently marked to warrant certain conclusions for the year's treatment.

On October 9 and 10, the fruits were counted upon the trees and divided into three grades, those entirely free from spot, those slightly spotted, and those unfit for market. At the same time the fruits rotting from the effects of the fungus *Monilia fructigena* were tabulated. This disease was quite abundant in the orchard, and owing to the fact that the entrance of the parasite into the fruit is generally through the ruptured epidermis, the two estimates are separated in the table; that is, fruits spotted which were rotting were counted twice, once as spotted and once as rotted. This method was used to make possible a true estimate of the action of the fungicides in preventing the fruit spot. Below is given a tabulated statement of the experiment. The untreated tree in each case stood to the right of the first tree of each plat in the adjoining untreated rows: thus No. 4, untreated, stood opposite No. 1, treated; No. 8 opposite No. 5, etc. The fruit was also counted, in addition to those just mentioned, on ten untreated trees at various intervals to left and right of the treated row on the two check rows. No choice was exercised in the selection of these trees. The average from these eighteen trees is used to compare the yield from each treated plat. In Plate VII the percentages are shown. Plate VIII represents the actual yield of fruit from each treated and untreated tree as well as the condition of the fruit at the time of picking respecting the amount of spot.

* Seven and one-half grams of $CuSo_4+5H_2O$ give, upon drying upon the leaf 8.54 grams of malachite, $CuCo_3+Cu(OH)_2$. Hence more than .1 of an ounce per gallon of water was used.

TABLE 27.—*Showing the result of the test of fungicides for the prevention of quince spot.*

	Treatment.	No. of treatments.	No. of fruits.	No. of rotted fruits.	No. of slightly spotted fruits.	No. of badly spotted fruits.	No. of fair fruits.	Per cent slightly spotted fruit.	Per cent badly spotted fruit.	Per cent rotted fruit.	Per cent fair fruit.	No. of spotted and rotted fruit.	Per cent saved from spot.
1	Bordeaux, 1:1000	5	40	5	.....	.....	35	.....	.....	12.5	87.5	.....	100
2	.....do	3	50	11	3	1	36	6	2	22	72	1	94
3	.....do	3	53	2	.....	.....	51	.....	.....	4	96	.....	100
4	Untreated	.....	78	11	10	7	51	12.8	8.9	14.1	65.3	3	79.4
5	Copper acetate, 1:1,000	5	79	5	.....	.....	74	.....	.....	6.3	93.7	.....	100
6	.....do	3	39	6	1	1	31	2.6	2.6	15.3	79.5	.....	95
7	.....do	3	69	3	5	.....	61	7.2	.....	4.3	88.5	.....	92.8
8	Untreated	.....	31	5	10	.....	16	32.2	.....	16.1	51.7	.....	67.7
9	Copper acetate, 1:505	5	51	12	.....	.....	39	.....	.....	23.5	76.5	.....	100
10	.....do	3	11	.....	.....	.....	11	.....	.....	.....	100	.....	100
11	.....do	3	16	2	.....	.....	14	.....	.....	12.5	87.5	.....	100
12	Untreated	.....	54	7	15	3	29	27.7	5.5	12.9	46.1	.....	66.6
13	Cloride of lime, 1:1.000	5	75	6	31	6	34	41.3	8	8	45.3	2	50.7
14	.....do	3	43	6	13	14	13	30.2	32.5	13.9	30.2	3	37.3
15	.....do	3	18	3	8	1	8	44.4	5.5	16.6	44.4	2	50.1
16	Untreated	.....	12	3	3	.....	5	25	.....	25	50	.....	66.6
17	Chloride of lime 1:505	5	54	9	22	19	10	40.7	35.2	18.5	18.5	6	24.2
18	.....do	3	51	8	24	10	16	47	19.6	15.6	31.3	7	33.4
19	.....do	3	77	7	27	24	25	35	31.1	9	32.4	6	33.8
20	Untreated	.....	106	8	26	24	52	24.5	22.6	7.5	4.9	4	56.6
21	Chloride of lime, 1:340	5	43	12	22	19	....	51.1	44.1	27.9	.....	10	4.8
22	.....do	3	89	21	49	23	12	55	25.8	23.5	13.4	16	19.2
23	.....do	3	62	6	38	4	17	61.2	6.4	9.6	27.4	3	32.4
42	Untreated	.....	44	8	15	6	17	34	13.6	18.1	38.6	2	56.8
25	Cop. carb. and glue, 1:1,000	5	68	4	4	.....	60	5.8	.....	5.8	88.2	.....	94.2
26	.....do	3	75	....	5	.....	70	6.6	.....	.....	93.4	.....	93.4
27	.....do	3	39	3	1	.....	35	2.5	.....	7.6	89.9	.....	97.5
28	Untreated	.....	64	4	26	.....	34	40.6	.....	6.2	53.1	1	59.3
29	Potassium sulph., 1:1,000	5	88	10	30	8	45	34	9	11.3	51.1	6	57
30	.....do	3	35	13	24	6	4	68.5	17.1	37.1	11.4	11	14.4
31	.....do	3	28	4	7	3	14	25	10.7	14.2	50	.....	64.3
32	Untreated	.....	58	16	22	3	24	37.9	5.1	27.5	41.3	7	68.9

From the foregoing table there are several facts readily seen.

(*a*) The trees treated with Bordeaux mixture gave 18.6 per cent more fruit free from spot than the adjoining untreated tree, and 42.9 per cent more than the average of eighteen untreated trees.

(*b*) Trees treated with copper acetate, 1:1000, gave 28.2 per cent more fruit free from spot than the adjoining untreated tree and 40.8 per cent more than the average of eighteen untreated trees.

(*c*) Trees treated with copper acetate, 1:505, gave 33.4 per cent more fruit free from spot than the adjoining untreated tree and 44.9 per cent more than the average of eighteen untreated trees.

(*d*) Trees treated with chloride of lime, 1:1000, gave 20.6 per cent *less* fruit free from spot than the adjoining untreated tree and 9.1 per cent less than the average of eighteen untreated trees.

(*e*) Trees treated with chloride of lime, 1:505, gave 26.1 per cent *less* fruit free from spot than the adjoining untreated tree and 24.6 per cent less than the average of eighteen untreated trees.

(*f*) Trees treated with chloride of lime, 1:340, gave 38 per cent *less* fruit free from spot than the adjoining untreated tree and 36.3 per cent less than the average of eighteen untreated trees.

(*g*) Trees treated with copper carbonate and glue mixture gave 35.7

per cent more fruit free from spot than the adjoining untreated tree and 39.9 per cent more fruit than the average of eighteen untreated trees.

(*h*) Trees treated with potassium sulphide gave 23.67 per cent *less* fruit free from spot than the adjoining untreated tree and 9.87 per cent less than the average of eighteen untreated trees.

CONCLUSIONS.

The following conclusions may be fairly drawn from the experiment:

(1) Five treatments gave a larger percentage of fair fruit than three when Bordeaux and copper acetate were used, but there was no advantage in the case of the other fungicides.

(2) The three most effective fungicides used were Bordeaux mixture, copper acetate, and the copper carbonate and glue mixture. The copper sulphate added to carbonate of soda forms copper corbonate. Of the three the Bordeaux mixture is to be preferred when all things are taken into consideration.

(3) The amount of spot was actually greater upon trees treated with chloride of lime and potassium sulphide than upon the untreated. This excess of spot increased regularly with the concentration of the solution of chloride of lime. Whether this chemical actually favors the growth of the fungus, as would appear from the above variation, must be determined by more extended experiments.

SPRAYING FOR FUNGOUS DISEASES OF THE GRAPE.

A PROFITABLE INVESTMENT.

Early in the spring of 1891 a bulletin* giving a brief account of several of the most destructive grape diseases and methods of combating the same was published by the Division of Vegetable Pathology. Twelve thousand copies were distributed among the grape-growers of the country, with a request that they give the remedies recommended therein a thorough trial and report the results at the close of the season. The main object of this request was to obtain some definite information as to the actual value in dollars and cents of the suggestions made by the Department. With this end in view there was sent in midsummer to 5,000 of the principal grape-growers to whom the bulletin above mentioned had been forwarded a copy of the following circular:

U. S. DEPARTMENT OF AGRICULTURE.
DIVISION OF VEGETABLE PATHOLOGY.

DEAR SIR: With a view of obtaining more definite information in regard to the losses occasioned in your section by black-rot, downy mildew, and anthracnose of the grape, as well as to get some reliable data as to the extent the various fungicides

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* Farmers' Bulletin No. 4, "Fungous Diseases of the Grape."

recommended by this Department are now used, the following questions have been prepared by the Chief of the Division of Vegetable Pathology. It is earnestly hoped that you will answer all of the questions, as far as you are able, returning the replies in the inclosed envelope on or before the middle of October next. The information collected in this way will be published in a forthcoming bulletin on diseases of plants and their treatment. This bulletin or any others issued by the Department will be gladly sent you upon your application.

Respectfully,

EDWIN WILLITS,
Acting Secretary.

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(1) Number of bearing vines grown by you.
(2) Number of nonbearing vines.
(3) Approximate yield of fruit in 1891.
(4) Per cent of fruit lost through the ravages of black rot in 1891.
(5) Per cent lost from downy mildew.
(6) Per cent lost from anthracnose.
(7) Did you or did you not treat your vines?
(8) If treated give the method adopted.
(9) Estimated per cent of fruit saved as a result of treatment.
(10) Average price of grapes per pound in your section.

Replies to this circular began coming in the middle of August, and by the 1st of December 2,500 answers in round numbers had been received. Without going into details it may be said that thirty-five States and two Territories sent in replies. The largest number, 242, was received from New York: the smallest, 1, from North Dakota. Of those replying to the circular 2,000, or 80 per cent, adopted one or more of the treatments recommended by the Department. Ninety per cent of those, or 1,800, reported beneficial results. Of the number of bearing vines treated, 40 per cent were sprayed or otherwise received applications of the Bordeaux mixture: 20 per cent were treated with ammoniacal solution, 15 per cent with Bordeaux mixture and ammoniacal solution combined, and the remainder, 20 per cent, with various fungicides, such as eau celeste, sulphur, etc. The answers to questions 4, 5, and 6 brought out the fact that by far the greatest loss in this country is due to black rot: downy mildew comes next, powdery mildew third, and anthracnose last. Stating this in percentages we have the following:

	Per cent.
Loss from black rot	65
Loss from downy mildew	25
Loss from powdery mildew	10

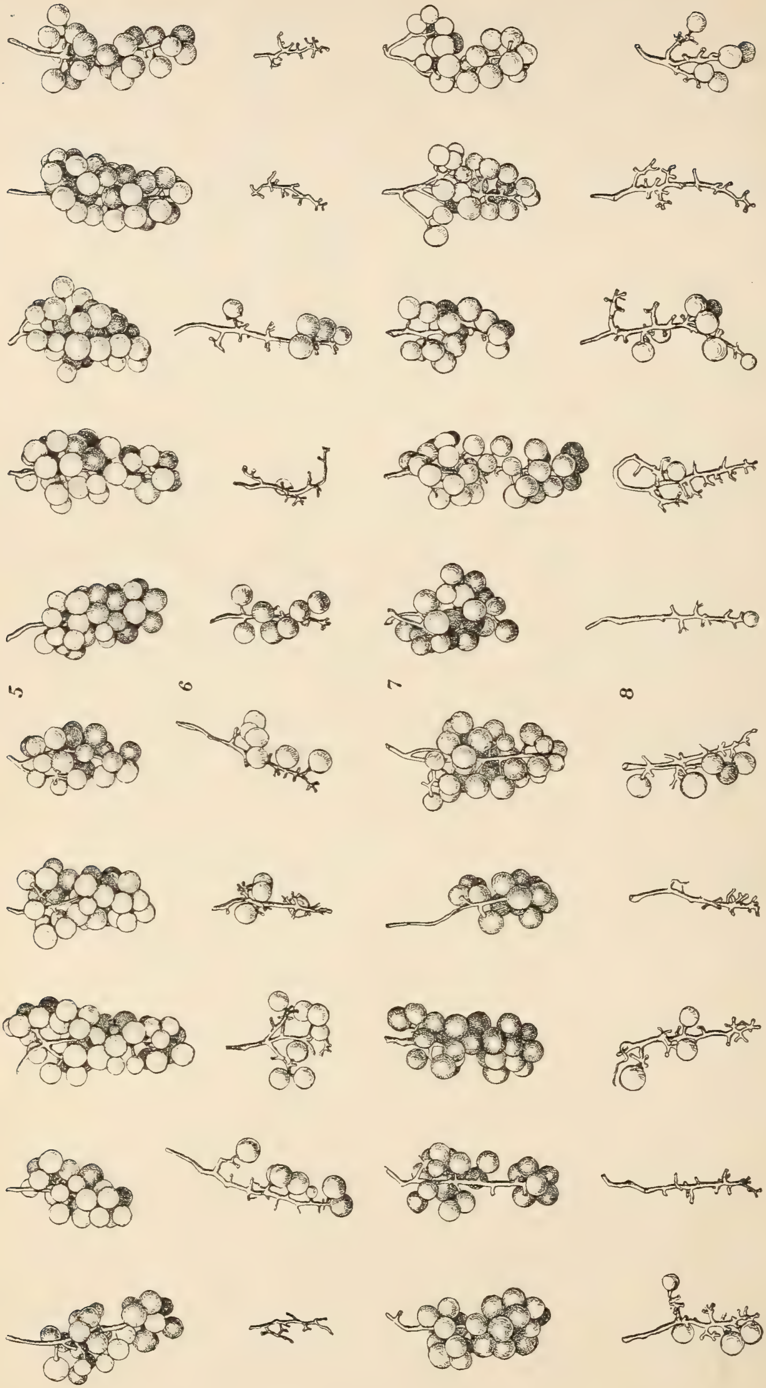
Of the 1,800 growers who treated their vines only 250 answered the questions in such a way as to give definite, reliable information bearing on the actual value of the work. Briefly, these 250 growers report an aggregate profit over all expenses of $30,733.89, or $122.93 for each grower. In the following table the estimated clear profit is given for each State:

TABLE 28.—*Showing clear profit in the treatment of grape diseases for each State separately.*

State.	Estimated clear gain.
Arkansas	$57.50
Connecticut	705.00
Delaware	2,160.00
Florida	69.83
Georgia	854.00
Illinois	1,018.14
Indiana	1,011.92
Iowa	202.12
Kansas	669.95
Massachusetts	366.10
Michigan	1,992.27
Minnesota	60.80
Missouri	250.00
Nebraska	262.80
New Jersey	309.01
New York	15,295.02
North Carolina	359.60
Pennsylvania	195.38
Tennessee	2,180.27
Texas	691.00
Virginia	1,153.08
Total	30,733.89

The only comment that perhaps need be made on the foregoing figures is to call attention to the fact that they represent probably not more than one-eighth of the total profit as a result of this work. Hundreds use the remedies who never report at all, and, while some fail, the majority, it is safe to say, reap some benefit from the work.

Black Rot of the Grape; treated and untreated. Bordeaux Mixture, full Strength.



BLACK ROT OF THE GRAPE; TREATED AND UNTREATED. BORDEAUX MIXTURE, HALF STRENGTH.

Fig. 1.—One Winter Treatment.

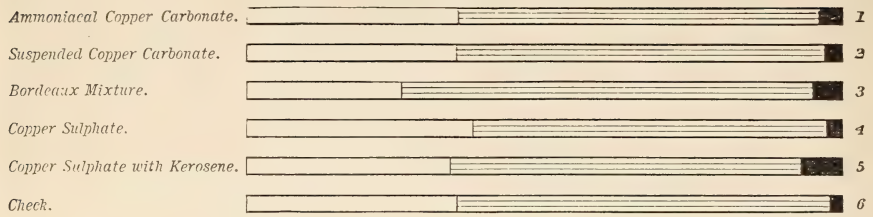


Fig. 2.—One Winter and One Spring Treatment.

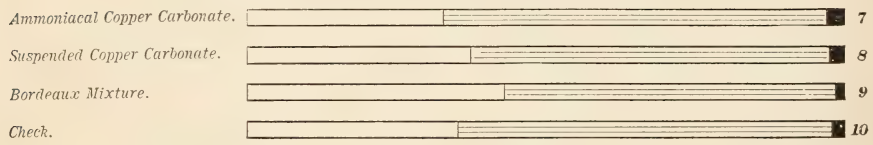


Fig. 3.—One Spring and Three Summer Treatments.

Fig. 4.—One Winter, One Spring, and Three Summer Treatments.

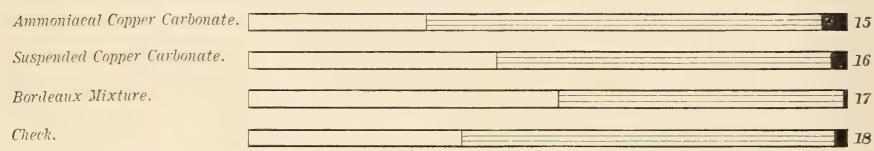


Fig. 5.—One Winter and Three Summer Treatments.

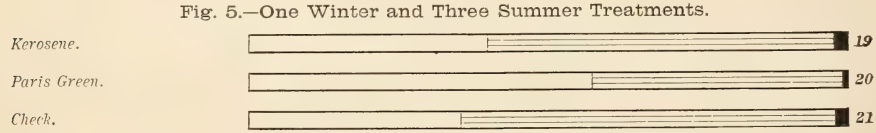
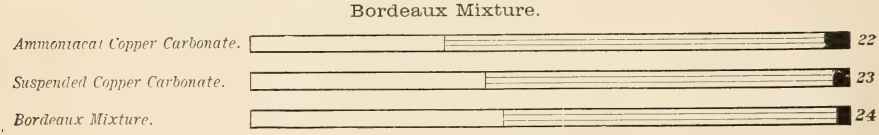
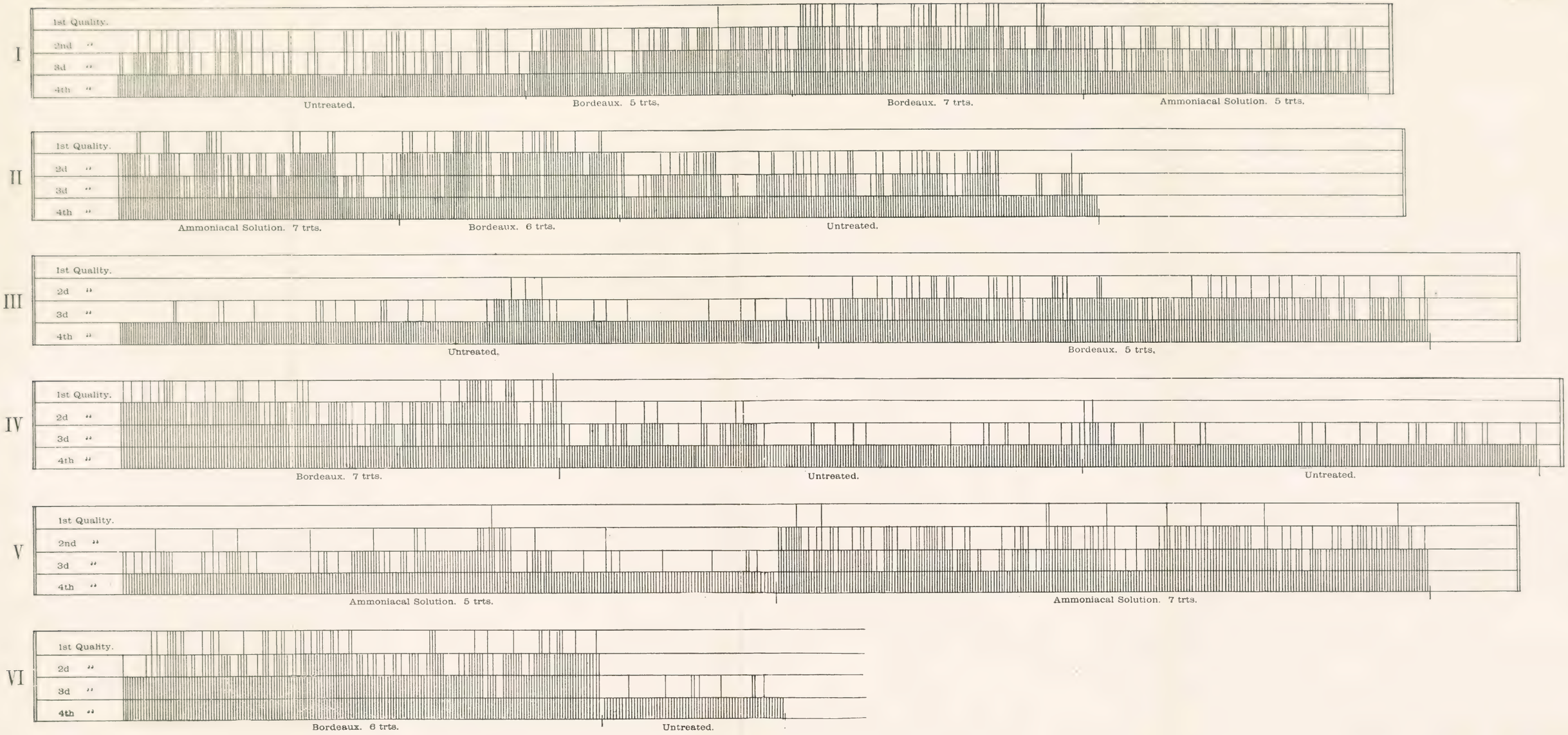
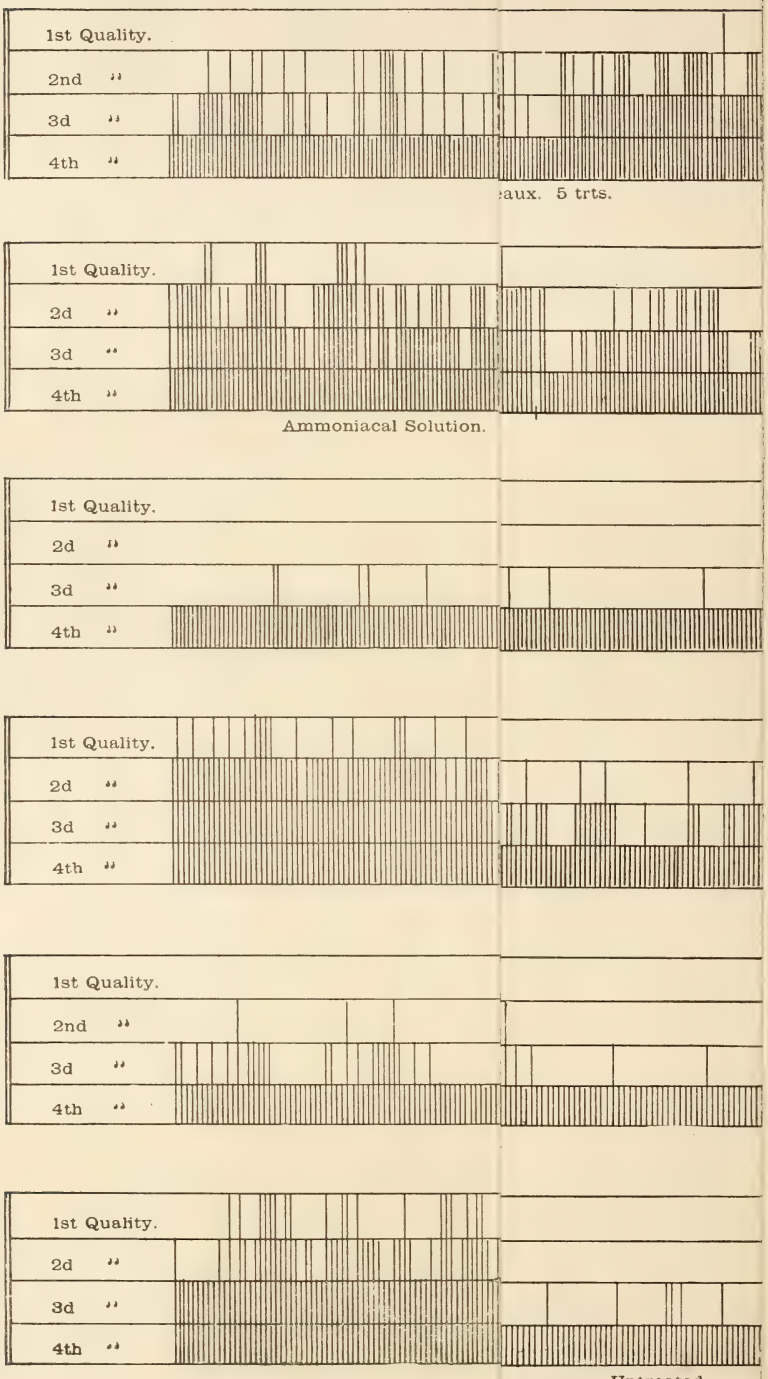


Fig. 6.—Average of the Eight Trees Treated with Copper Carbonate and Bordeaux Mixture.





PEAR LEAF-BLIGHT. RECORD OF TREATED AND UNTREATED FRENCH AND AMERICAN STOCK. MULLIKIN, MD., AUGUST 24, 1891.


I
1st Quality.
2nd ,,
3d ,,
4th ,,
aux. 5 trts.
II
1st Quality.
2d ,,
3d ,,
4th ,,
Ammoniacal Solution.
III
1st Quality.
2d ,,
3d ,,
4th ,,
IV
1st Quality.
2d ,,
3d ,,
4th ,,
V
1st Quality.
2nd ,,
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VI
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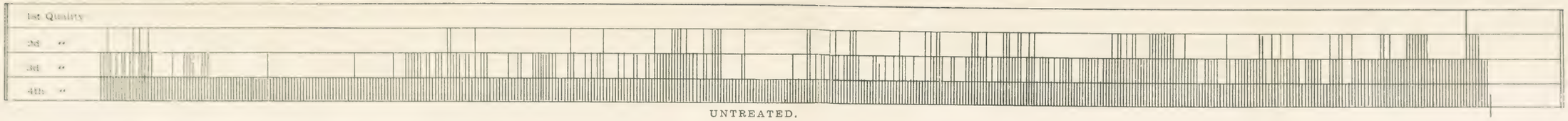
Untreated.
ORD OF TREATED AND UNTREA

I

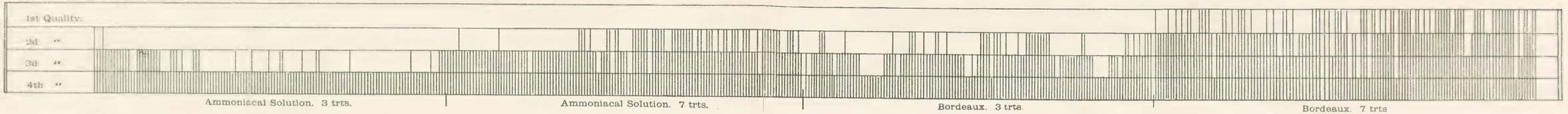
FRENCH PEAR STOCK.



UNTREATED.

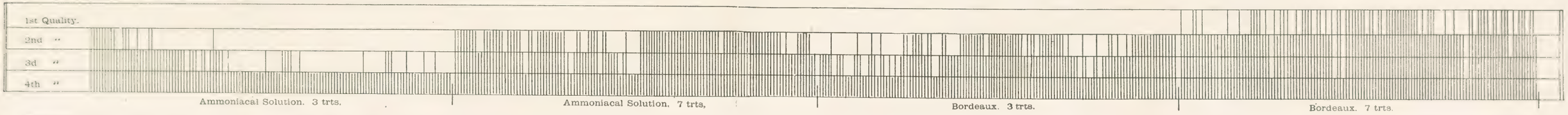
II

FRENCH PEAR STOCK.



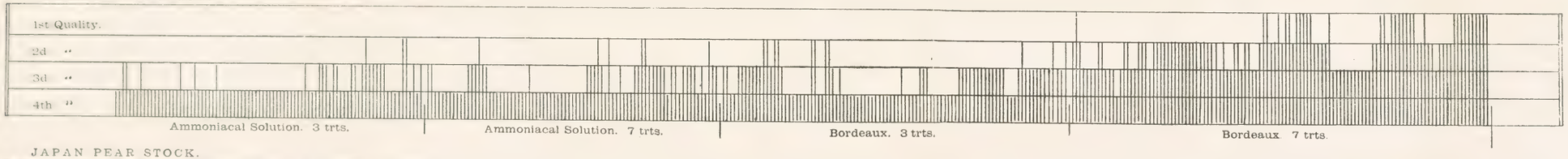
III

FRENCH PEAR STOCK



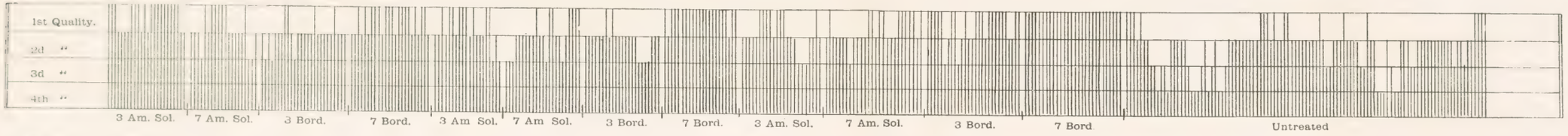
IV

FRENCH PEAR STOCK.



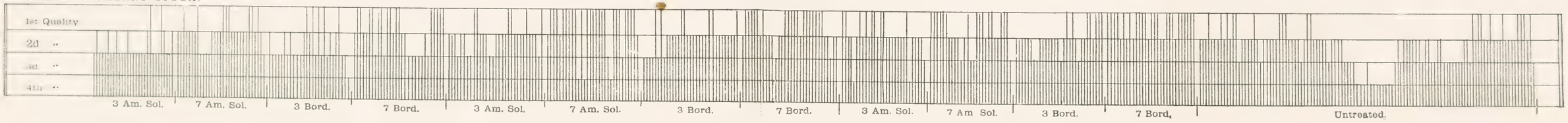
V

JAPAN PEAR STOCK.

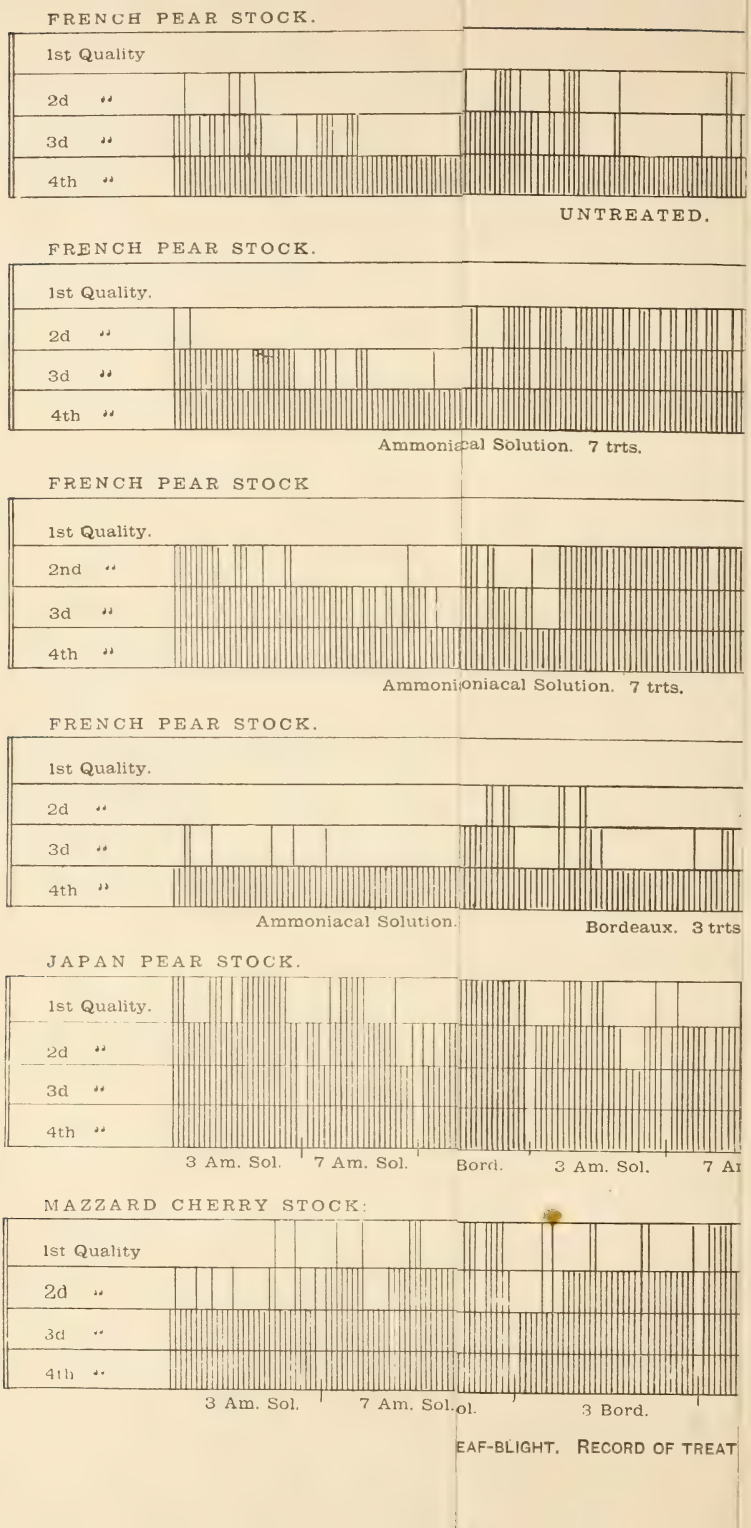


VI

MAZZARD CHERRY STOCK.



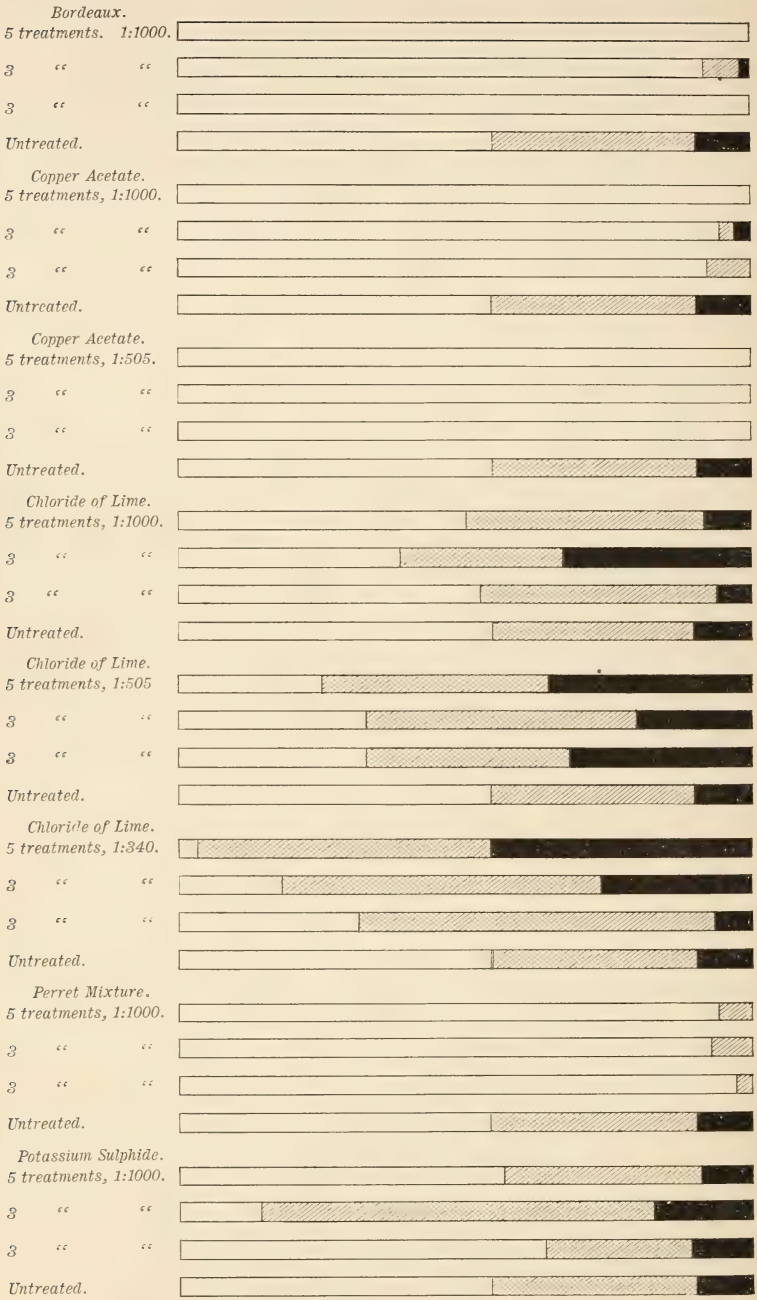
PEAR AND CHERRY LEAF-BLIGHT. RECORD OF TREATED AND UNTREATED STOCK. GENEVA, N. Y., SEPTEMBER 21, 1891.


FRENCH PEAR STOCK.
I
1st Quality
2d "
3d "
4th "
UNTREATED.
FRENCH PEAR STOCK.
II
1st Quality.
2d "
3d "
4th "
Ammoniacal Solution. 7 trts.
FRENCH PEAR STOCK
III
1st Quality.
2nd "
3d "
4th "
Ammoniacal Solution. 7 trts.
FRENCH PEAR STOCK.
IV
1st Quality.
2d "
3d "
4th "
Ammoniacal Solution.
Bordeaux. 3 trts
JAPAN PEAR STOCK.
V
1st Quality.
2d "
3d "
4th "
3 Am. Sol.
7 Am. Sol.
Bord.
3 Am. Sol.
MAZZARD CHERRY STOCK.
VI
1st Quality
2d "
3d "
4th "
3 Am. Sol.
7 Am. Sol.
3 Bord.
EAF-BLIGHT. RECORD OF TREAT

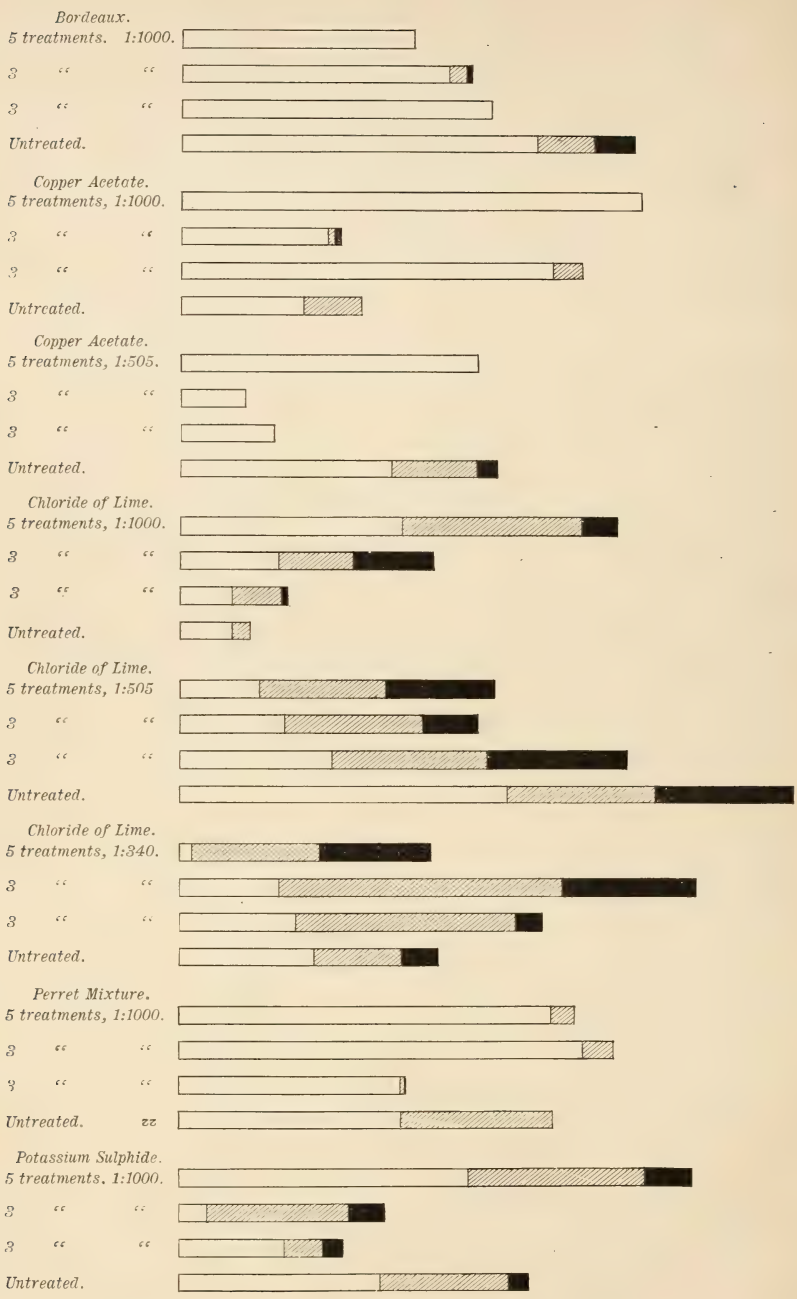
TREATED.

UNTREATED.

PLUM LEAF-BLIGHT IN NURSERY. TREATMENT WITH BORDEAUX, WEAK STRENGTH. GENEVA, N. Y.



QUINCE FRUIT-SPOT. PERCENTAGE REPRESENTATION. GENEVA N. Y.



QUINCE FRUIT-SPOT. REPRESENTATION OF ACTUAL YIELD. GENEVA, N. Y.

EXPLANATION OF PLATES.

PLATE I. Black rot of grape. Shows the result of treatments with Bordeaux mixture full strength, applied early. Figs. 1 and 3 clusters from treated plats from which rotten berries were removed. Figs. 2 and 4 clusters from adjacent untreated plats with rotten berries removed. Collected July 10. Redrawn from photographs.

PLATE II. Black rot of grape. Shows the result of treatments with Bordeaux mixture, half strength, applied early. Figs. 5 and 7 treated; 6 and 8 untreated. Prepared same as Plate I.

PLATE III. Apple scab. Shows graphically in percentages the result of experiments at Madison, Wis., in the treatment of the disease. The fruit when harvested was graded into 1st, 2d and 3d qualities. The averages from two trees are represented by white for 1st quality, lines for second quality, and black for 3d quality. Figs. 1, 2, 3, 4, and 5 explain themselves. Fig. 6 is made up from the same data as 1, 2, 3, and 4, but represents averages of eight treated trees instead of two.

PLATE IV. Pear leaf-blight. Shows condition of treated and untreated stock August 24, at Mullikin, Md., as regards leaf-blight. Figs. I and II represent Japan stock, III, IV, V and VI French stock. Each perpendicular line represents a single stock, and the horizontal line to which it reaches indicates its condition as regards leaf-blight. Thus, for instance, the first stock in Row I was graded as 4th quality, the second as 3d, and so on. The treatment which each stock received is printed below the section in which it is contained. Sections are separated by a short line extending below the base line. Grading of stock done by Messrs. Dorsett, Swingle and Fairchild.

PLATE V. Pear and cherry leaf-blight. Shows condition of treated and untreated stock in the experimental block at Geneva, N. Y., as regards leaf-blight. September 21. Composition of Plate is the same as that of Plate IV. Grading of stock by Fairchild.

PLATE VI. Plum leaf-blight in nursery rows. Shows result of treatment with weak Bordeaux mixture, Geneva, N. Y., from photographs taken September 19, 1892. Representive sections from treated and untreated rows.

PLATE VII. The percentage of fruit free from spot is shown by the black portion of the bars; that slightly spotted or of second quality, by lines slanting to the left; and that badly spotted, as black. Each $\frac{1}{2}$ of an inch represents 1 per cent of fruit. The last bar of each series represents the percentages derived from the average of eighteen untreated trees.

PLATE VIII. Shows the actual number of fruits borne on each tree in the experiment and the condition of such fruit as regards spot. The classification, as regards condition, is the same as in Plate VII. Each $\frac{1}{2}$ of an inch in length represents a single fruit.

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